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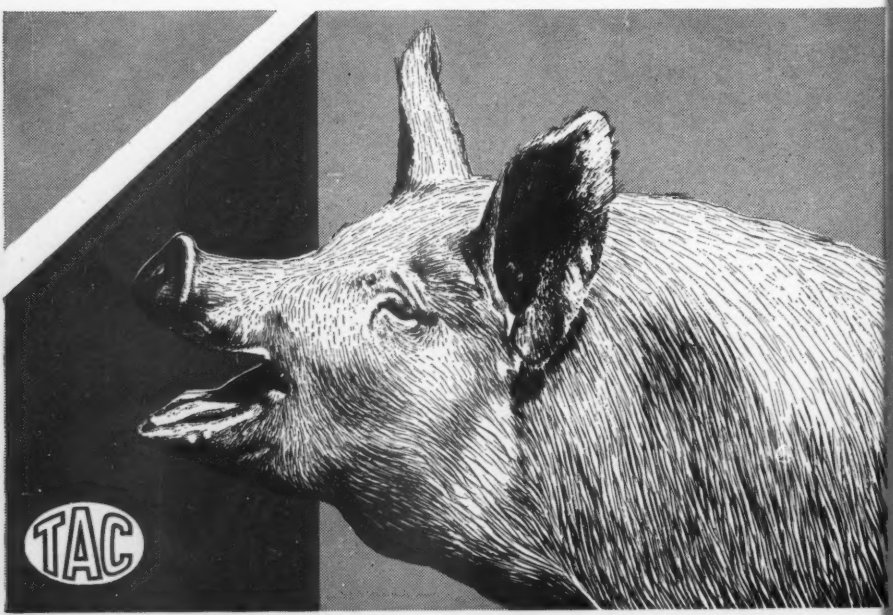

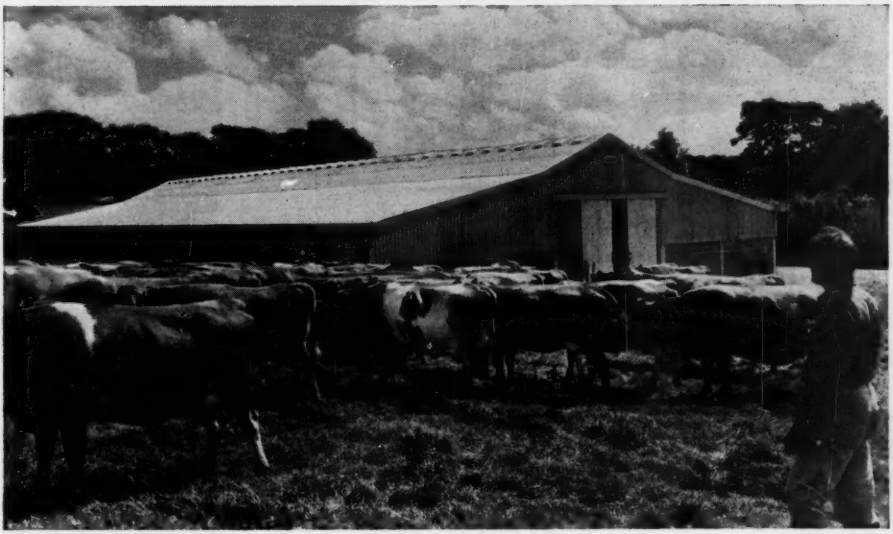

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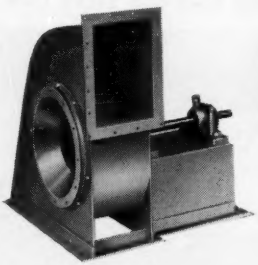

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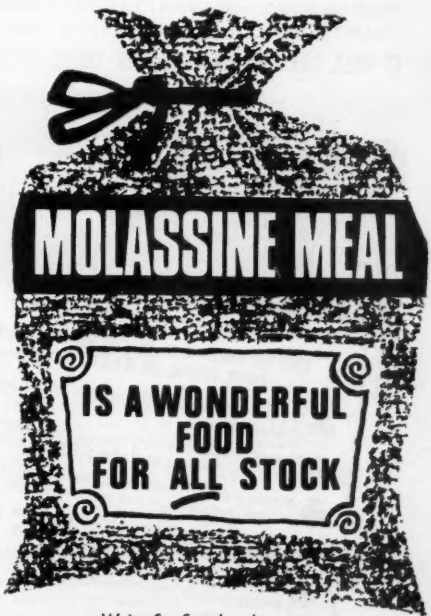

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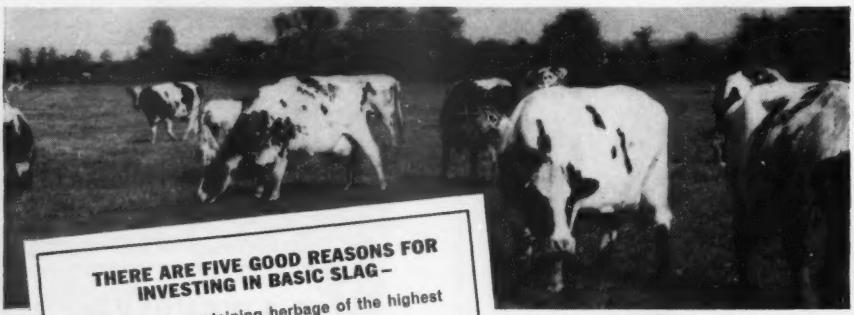

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Agriculture

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Quality and Reliability

FARMERS and growers expect quality and reliability in the supplies and requisites they buy. Indeed, in some fields such as seeds, fertilizers and feedingstuffs, the farmer-buyer is protected by legally required declarations. For the control of pests, diseases and weeds in crops the farmer can buy officially approved chemicals. Purchasers insist on and generally obtain reliable machines; in this sector they have an additional aid in the test reports of the National Institute of Agricultural Engineering, which can be obtained for a small annual subscription. Above all, the continued successful operation of the whole agricultural industry depends on the known and proven quality and reliability of the men employed in it.

Equally, and to an increasing extent, consumers demand that the farm products they purchase should be of good and consistent quality. In some commodities, such as milk, presumptive minimum standards are prescribed by law. Dairy farmers are paid for their milk in accordance with its quality. The farmer producing vegetables for freezing risks the rejection of all or part of his crop, if the standards required by the contract are not attained. As shopping patterns and consumer preferences alter, due to the increase in self-service stores and the expanding demand for the so-called convenience foods, the need to produce standard gradeable commodities of proved reliability will increase. Regulations prescribing national statutory grades for apples, pears, cucumbers, tomatoes and cauliflowers sold through wholesale channels are to be introduced under the Horticulture Act 1964. Starting dates for apples and pears have been planned for July this year and for the others in 1968.

Ever-rising production has brought farming to the stage where good quality pays better than sheer quantity. In the future, it may be very difficult to sell poor quality produce and, as a result, farmers will have to be much more concerned about market demands, both in the short and the long term. Quality and Reliability Year, which has been launched by the British Productivity Council in association with the National Council of Quality and Reliability, will be an impetus to farmers and growers who wish to remain competitive.

H. STEPHEN BURTT

Chairman, Agricultural Productivity Committee, British Productivity Council

Cereals on the Chalk

Pat Jones

Director, Bridget's Experimental Husbandry Farm

A GLANCE at a soil map will readily show how widespread chalk soils are in the south and east of England and a study of agricultural statistics will indicate the importance of cereals on such soil types. It is not surprising, therefore, that as Bridget's Farm is situated on the chalk ridge which rises northwards from the valley of the River Itchen, cereals feature prominently in the cropping each year. This is in spite of the fact that grass has to be grown for the dairy herd of approximately 150 cows and a ewe flock numbering 300. Because these leys are ploughed after three or four years duration and followed by wheat, the cereal acreage on the farm is divided roughly into equal areas of winter wheat and spring barley. This is less typical of the area as a whole, where the proportion is nearer three of barley to one of wheat. Oats are now relatively unimportant.

Over the last ten years, the average yields at Bridget's have been 36·7 cwt per acre of winter wheat and 33·5 cwt of spring barley, but 45 cwt crops of both wheat and barley are often obtained and yields exceeding 50 cwt per acre are sometimes reported. Proctor has been for many years the most widely grown barley variety but its popularity is now seriously challenged by newer varieties such as Impala and Deba Abed. Cappelle Desprez has been the most popular winter wheat variety grown on the chalk during the last decade and is still the most widely grown today. Strangely enough, spring wheats have never become very important, but with some of the newer varieties showing promise of higher yields, the acreage is likely to increase as farmers realize their potential.

Pests and diseases

Wheat is the most favoured of the cereals in the rotation and is always the first crop taken after the break crop. It is quite usual to take two wheat crops in succession after a two-to-three-year ley, but after a one-year

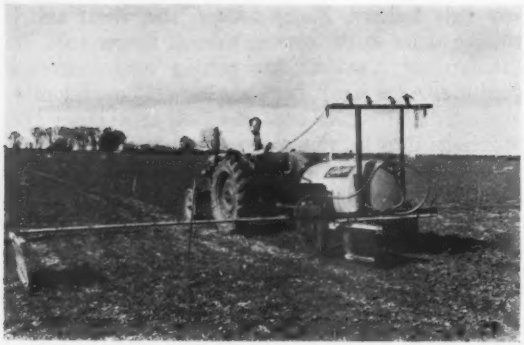
break a single wheat crop only follows. Barley follows the wheat and is commonly grown four or five years in succession, though longer runs are occasionally found. Some farmers, however, are getting very concerned about a system of monoculture. As a result they are showing considerable interest in such crops as winter and spring beans and oil seed rapes as a means of breaking the sequence, thus helping to control pests and diseases and allowing the more profitable wheat crop to be reintroduced into the rotation. Such cereal pests and diseases are equally trying on the chalk as elsewhere and, because of the intensive cereal cropping, certainly lead to reduced yields on some occasions. Eyespot seems to be less troublesome than take-all in winter wheat, probably because of the popularity of Cappelle Desprez. In barley take-all can be severe, but recent research has shown that, after an initial build-up, a natural decline begins after the fourth or fifth crop enabling other barley crops to be taken without further loss. The main doubt really is the value of a one-year's break in the rotation. Certainly, with a heavy infestation, a temporary improvement in the disease position will result in the cereal following the break, but the build-up quickly follows again and instead of a steady decline the diseases tend to persist and often become more severe. It would appear wiser, therefore, to grow two break crops in succession, particularly if this enables a better control of couch to be obtained. Dirty fields are often a feature of intensive cereal rotations, which helps the carry-over of the diseases. It is perhaps for this reason that some farmers prefer to cultivate between crops rather than plough. By so doing the couch is constantly moved and brought to the surface and thus prevented from getting a real hold.

Cereal root eelworm is very widespread on many chalk farms, but fortunately barley seems to be able to withstand a fairly heavy attack provided good cultivations and high fertility favour the crop. It is only when oats are introduced that crop failures are likely to occur. Mildew is an annually-recurring problem of varying intensity and can have significant effects on yields. Leaf blotch has spread at an alarming rate during the last few years and some infected plants can be found in most crops. Unfortunately, there is not an economic cure for these diseases and all a farmer can do is to select those varieties which show some resistance to them.

Fertilizers for wheat

Evidence from experiments carried out at Bridget's has shown that, after a well-managed ley or heavily-fertilized break crop such as potatoes, winter wheat does not respond to either phosphate or potash and, as a result, it is quite usual to drill the crop without any of these fertilizers in the seedbed. The second wheat crop usually receives 30 to 40 units of both P and K per acre, as do succeeding barley crops. Combine drilling for both crops is still widespread but bulk purchasing of fertilizers has led to an increase in the use of spinners, and where this is so, farmers are tending to replace their combine drills with narrow-row single-purpose implements.

The levels of nitrogen applied vary considerably, but a great deal of work has been done to establish the levels most likely to produce an economic return. As a result of a considerable number of experiments, it has been found that no autumn nitrogen is required for winter-sown wheat provided sufficient is put on as a top-dressing in the spring. On average, 80 units of nitrogen are required to give optimum yields, although in some years no



A Chafers' sprayer in operation on one of the plots

response over 60 units can be obtained. This requirement does not seem to vary according to the previous crop, although what little evidence is available suggests that for wheat after beans the quantity of nitrogen can profitably be reduced by 30–40 units. The time of application of these 80 units has been studied and the evidence is mostly in favour of late-spring applications. For instance, mean yields over the four years 1962–1965 show that 80 units in April increased the yield of grain by 1·3 cwt per acre compared with the March application, while an early-May dressing gave an additional 0·4 cwt. Best results were usually obtained, however, by a split dressing of 40 units in March/April followed by the remaining 40 units in early May. Many chalkland farmers are prepared to split their applications in spite of the extra work involved, because the extra 0·8 cwt per acre over the single May dressing is an economic return. Many used to worry about the damage caused to the crop by driving a tractor and fertilizer distributor through in early May, but it has never been possible to measure a reduction in yield as a result of this operation at that time.

Types of nitrogen have also been fully investigated, again over a four-year period. Included in these trials were liquid fertilizers based on a mixture of urea and ammonium nitrate as well as sulphate of ammonia and quicker-acting types such as Nitro-Chalk, nitrate of soda and, in one year, Nitram. The application of the top-dressing as a liquid was an easy and labour-saving method and gave yields almost identical to those obtained from sulphate of ammonia. The nitrate type of fertilizers, however, gave on average an additional two cwt of grain per acre. Much of this increase was obtained in one of the four years (1962) but in two further years some increase occurred and it is safe to conclude that, on chalk soils, a nitrate type of fertilizer is to be preferred to an ammonium one. It is for this reason that, in spite of the lower cost per unit, sulphate of ammonia is less widely used for this purpose than it used to be.

Fertilizers for barley

Investigations on nitrogen requirements for spring barleys are still continuing, aimed at determining the quantity of additional fertilizers required under an intensive system. It has been found that for a barley crop only two to three crops away from the break crop 60 units of nitrogen per acre can be justified in most years, although often for a kale crop no more than 40 are

required. However, evidence is accumulating that the further away the barley crop is from the break the more nitrogen is required to maintain yields at an economic level. To keep yields around the 30 cwt per acre level, it seems that up to 120 units are necessary for the seventh or eighth continuous crop. At this stage it begins to become a doubtful economic proposition to increase much beyond this level and only rarely do you hear of chalkland farmers exceeding this. Fortunately, there is some evidence to suggest that, to obtain the maximum benefit from these heavier quantities of fertilizer, they should not all be put on the seedbed but that half should be put on during seedbed preparation and the remainder broadcast four to five weeks later. Most farmers who are working at these higher levels are quite happy to split this application into two, and sometimes three, dressings.

The weed problem

Couch remains the main weed problem on most chalkland farms, mainly because selective chemical control in the presence of a cereal crop is not possible. Real efforts are made after harvest to clean the stubbles by cultivating as soon as the straw is removed. A rotavator is often brought in on the worst fields to chop the couch into smaller pieces and allow for better burying when the field is eventually ploughed. Broad-leaved weeds are controlled by selective sprays. The costs of chemical weed control are rising, however, and many farmers are beginning to realize that a complete kill of weeds does not necessarily lead to an increased yield of grain. For this reason they are more careful in the selection of the fields to be treated, spraying only those where the weed population is so high as to reduce yields.

Articles from the Ministry's Experimental Husbandry Farms will, in future, appear regularly in *Agriculture*. This, the first one, is from the Farm Director of Bridget's, **P. J. Jones, B.Sc.,** who is seen here talking to visiting farmers.

A. Eden

The Use of Beans in Animal Feeding

BEANS traditionally were a heavy-land crop grown in preparation for the wheat crop to follow. In the days when the main motive power on the farm was the horse, beans were extensively used with oats, chaff and hay for its 'bait', especially when heavy work such as ploughing had to be done. Gradually the crop fell into disfavour, most probably because of diminished yields through the ravages of pests and diseases and because the greater general use of nitrogenous fertilizers meant that less dependence was placed on beans for adding nitrogen to the soil. There were, however, some farmers who, having found a strain of beans suited to their particular soil and who took the art of growing beans seriously, continued with the practice, and these strains have been the parent stock used by plant breeders for the improved varieties of beans now coming on to the market. Moreover, the development of chemical control of weeds and of many of the pests that formerly took serious toll of the crop enabled beans to give a better yield and a higher economic return from the land on which they were grown. Further, the crop has gained in importance because of its value as a break in the succession of growing cereals and in assisting a better balanced type of rotation.

Composition and nutritive value

The bean as a typical leguminous seed is characterized by being a most useful source of protein, some $2\frac{1}{2}$ to 3 times as high as that of average cereals. It is also rich in starch, with a modest level of fibre, intermediate between that of barley and oats. Contrary to what is sometimes stated, the bean

itself is a relatively poor source of calcium and it is low in chlorides, but it has a phosphorus content at least as high and usually higher than that of cereals.

Typical compositional figures are:

	%
Dry matter	86
Crude protein	25
Oil	1·5
Crude fibre	6·5
Soluble carbohydrates	50
Total ash	3
Calcium (Ca)	0·15
Phosphorus (P)	0·4
Chlorides as salt (NaCl)	0·1

Compared with the richest vegetable protein sources such as groundnut and soya bean meal, beans have only half their level of protein, but farmers are apt to be misled by those who point out that beans at £27 a ton with a 25 per cent protein content are an expensive form of protein compared with these richer sources. This comparison, however, does an injustice to beans, as it makes no allowance for their being a mixed starchy-protein concentrate. In terms of nutritive value, both as a source of energy and of digestible protein, 2 cwt of beans are the equivalent of a cwt of barley and a cwt of soya bean meal. In sheer monetary terms, therefore, beans are worth at least £34 a ton, so that in effect their use at the price quoted must be an economic advantage, especially for the farmer who is prepared to grow beans for his own stock-feeding uses.

Arguments that bean protein is decidedly inferior in biological value will not stand impartial examination. As a source of the amino acid, lysine—perhaps the primary essential amino acid—beans at 1·8 per cent compare favourably with groundnut at 1·5 per cent, and although inferior to soya bean meal with 2·5 to 3 per cent lysine, this difference vanishes with the double rate of usage of beans compared with soya. The fact is that beans as a home-grown source of protein are a safe and useful food for all classes of livestock.

Physical forms of feeding

Apart from the fact that whole beans are sometimes fed to ewes and rams at the time of tupping, beans need some physical treatment before being fed to farm livestock. This treatment may consist of rolling or cracking to burst the hard seed-coat, or of grinding to produce a meal. Beans are usually harvested late in the season after the corn harvest is over, and new beans are generally rather high in moisture content (about 20 per cent), making grinding slow and difficult. In the distant past beans were often hand picked, less distantly harvested by binder and stacked when they tended to dry out slowly, and, of course, in modern times they are combined. Up to the beginning of World War II many farmers would not use beans until they had been stored for a year, by which time the seed-coats had blackened and wrinkled. Beans were then sufficiently dry to grind without difficulty.

Possibly because of this higher moisture content, bean meal has a tendency to 'heat' on storage and is liable to cause scouring in consequence. Hence it is best to grind beans as they are required, and unless they have been well

dried beforehand it is inadvisable to prepare more than a week's supply at a time. Perhaps for this reason bean meal is a rare commodity on the market, and most users prefer to grind supplies as they need them.

Uses in stock-feeding

Beans are often alleged to have a binding or costive action, but this statement has little significance outside the context of the remaining foods offered to stock. One interesting feature of the use of beans is their property of producing a firm, white fat in the carcasses of meat-producing animals, especially porkers, and this is a valuable point of consumer-appeal.

A good calf meal can, with advantage, include up to 15 per cent bean meal. Calves from four to nine months of age will thrive on a concentrate mixture of equal parts of cracked beans and rolled cereals, with the normal addition of minerals and fat-soluble vitamins in appropriate supplements.

The protein needs of cattle above nine months of age are modest considered against the needs of younger cattle, and for early intensive finishing a bean/cereal diet in the ratio of 1 : 5, plus minerals and vitamins, will provide all the protein required.

Beans can form the sole protein supplement to cereals in producing balanced dairy mixtures, but for the sake of variety it is more usual to provide at least two sources of protein. In theory beans and cereals can be used in about equal proportions, but it is rare for beans to comprise more than about a quarter of the total concentrate diet. A useful dairy mixture is 12 cwt cereals, 4 cwt beans, 3 cwt soya bean and ½ cwt dairy minerals, but the exact make-up of a dairy ration is often determined by what is readily available and the relative costs of the foods to be directly purchased.

Maintenance rations

There is a growing interest in dispensing with hay and silage and making greater use of barley and oat straw. Proprietary lowish-protein mineral-vitamin supplements are now available for mixing with barley to supply at least three-quarters of the energy needs for maintenance, the balance being made up with *ad lib.* access to straw, and all milk is fed for by conventional concentrates. The nutritional contribution of the straw is therefore small, but the consumption of a minimum of 7 lb is sufficient to provide the long roughage necessary for the synthesis of butterfat. This system, however, is not dependent upon any one particular type of supplement for use with the barley and the straw. A mixture of 15 cwt barley, 5 cwt beans and ½ cwt dairy minerals (plus added vitamins A and D), when given at 8 lb a head daily, will cover all protein requirements and about 80 per cent of the cow's energy needs for maintenance, leaving the balance to be made up by the use of about 8 lb barley straw or, if preferred, 5–6 lb average hay. Indeed, there are distinct possibilities of using a single-purpose concentrated food that will provide for both maintenance needs and production.

A mixture providing 11–11·5 per cent digestible protein with a reasonably high energy level can be devised such that 7 lb are fed for maintenance with between 6 and 10 lb straw, or 5 lb mixture plus 10 lb average hay, and 4 lb fed for each gallon up to and including the sixth. This has a slight marginal deficiency of protein at the higher levels of production, but this is unlikely to have any serious consequences. One example of such a mixture is 12 cwt

barley, 2 cwt beet pulp (or oats), 5 cwt beans, 1 cwt soya bean meal (or groundnut), ½ cwt dairy minerals, plus a vitamin supplement to supply 4 million units of vitamin A and 1 million units of vitamin D.

The system undoubtedly involves a liberal use of beans and, assuming an average level of 4 gallons of milk per cow per day, involves 23 lb concentrates of which almost 6 lb are beans, or a requirement of 10–11 cwt beans for each cow over the whole winter period. It offers this practical advantage in that feeding for the first one, two or even three gallons can be effected outside the milking unit, an appreciable advantage when large numbers of cows are being milked and where the time available to consume concentrates within the unit places a limitation on the rate of throughput. It requires adequate outside feeding space (at least two feet of manger run per cow), and the cows are given free access to the long roughage overnight.

Pigs and poultry

For these species, more sophisticated diets are usually necessary, but in broad principle beans can provide the necessary supplementary vegetable proteins. Except for very special diets the use of soya bean meal is unlikely to exceed 10 per cent, and this can be replaced by 20 per cent beans with a corresponding reduction in the quantity of the lowest energy cereal of the dietary. Beans in no way diminish the need for the use of the more conventional animal protein foods, but their employment does normally slightly lower the costs of the diet without impairing its efficiency.

Renewed interest

The rising world demand for protein foods is leading to a hardening of prices and hence increased costs of foods for all classes of livestock. The renewed interest in the growing of beans where soil conditions are favourable and the better economic returns from improving yields are, therefore, most timely, both in a partial alleviation of shortages of the better classes of vegetable proteins and in helping to curtail the consequent rises in costs of animal production.

This article has been contributed by **Dr. A. Eden, M.A., F.R.I.C.**, who is now in his 31st year with the Ministry. He is the senior Animal Nutrition Specialist in the Eastern Region of the National Agricultural Advisory Service and is stationed at Cambridge.

Farm Effluent

The first of a series of articles on the disposal of farm effluent will appear in *Agriculture* shortly.

Health and Intensive Sheep Production

J. A. Watt

WE are constantly assured by many authorities that, if sheep farming is to survive, intensification is essential. There are many angles to this problem, but one which is often neglected till it asserts itself in no uncertain fashion, is the effect on the health of the flock. It would be foolish to say that the answers to all the problems are known, but it is even more foolish to embark on a change of husbandry of this nature without utilizing all the knowledge which is available. The prevention of disease and the maintenance of health, which are nearly but not quite synonymous terms, are of utmost importance in the economics of production and it must be realized that they are not covered by vaccines and medicines alone. When husbandry moves from the traditional and tried methods in any form of livestock management, there are risks to the health of the animals involved. This may result in the development of a specific disease, e.g., intestinal worms in grazing animals or pneumonia in housed ones, but the most important point is that the disease in many cases is the result of management and feeding factors, not the mere presence of the parasite or germ. In other words, if conditions are made difficult for the animal it is liable to become ill and it is often possible to name a specific disease as the cause, but the mere treatment of this disease is at best palliative if the predisposing management fault is not corrected.

Systems of intensification

In sheep farming, intensification takes two forms. One is entirely outdoor, with forward creep and paddock grazing and other modifications; the other is dependent on the housing of all or part of the flock for varying periods. Combinations of these two methods are also being tried and each one presents its particular problems and hazards. It would not be possible in a short article to deal with these varying systems individually. Indeed the problems are often such that the preventive measures must be tailored to suit the farm, and this is most certainly the province of the veterinary surgeon who is familiar with the problems involved. However, there are certain risks which can be foreseen and others which have come to light with experience. As housing of sheep is the least familiar system and it is the ultimate in intensification, this form of husbandry is dealt with first, though the conditions, which are the direct result of the concentration of animals, apply equally to any system.

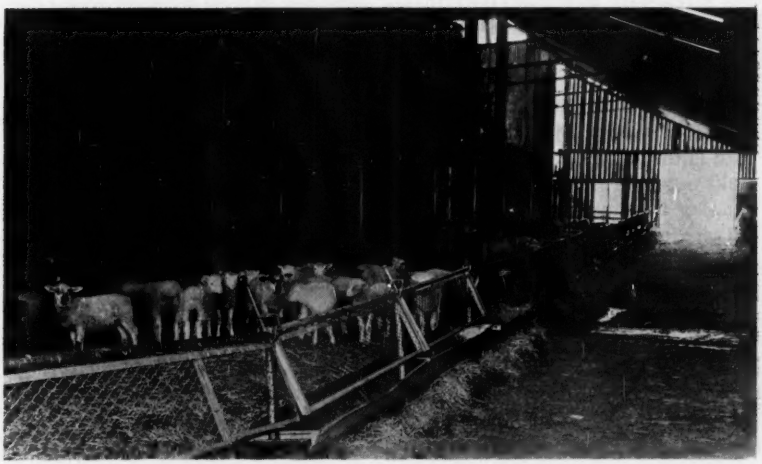
Housing for sheep

Housing of sheep for the winter or for the shorter period of lambing is no new departure in husbandry. In Britain, housing was regularly practised in past centuries and in Scandinavia and Iceland it is normal today. The changing face of agriculture in Britain, however, resulted in this practice falling into disuse and, with its abandonment, the know-how has largely vanished. For this reason, amongst others, housing must be approached with caution and a full realization of the risks involved. The reasons for the adoption of this type of husbandry and its economics need not concern us here, apart from the obvious fact that the health of the housed animals has a very great influence on the results which may be obtained.

While we can draw on the experience of other countries to some extent, the conditions and breeds of sheep involved, as well as several minor factors, make it dangerous to depend too much on experience elsewhere. While some sheep farmers have now had several years experience of the system, it has not been sufficiently extensively adopted, or in use long enough, for anyone to have gained a full knowledge of the disease implications. On the other hand, attempts to adopt this form of husbandry have highlighted certain important aspects and the results of some mistakes have become obvious. We have therefore been able to formulate certain principles which will give control over the health problems most likely to be encountered.

It would obviously be quite impossible in this article to cover all the illnesses which are favoured by intensive husbandry systems. It is nevertheless necessary for the stockowner to appreciate the significance of housing, and feeding and management factors, in the actual causation of disease. For this reason a few, well-recognized conditions have been singled out for mention, not only because of their importance in themselves, but because they serve to illustrate why certain practices are advocated. The province of disease, its correct diagnosis, and the curative and preventive measures to be adopted, are the primary concern of the farmer's own veterinary surgeon. The farmer, for his part, must realize that the field of veterinary

Adaptation of farm shed for sheep housing. The wall on the left is of straw bales. Note adequate ventilation



Pens for housed ewes

medicine is not confined to the administration of medicine to ailing animals but extends into the environmental and management conditions which so strongly influence disease.

Infectious disease

The infectious diseases described are not, of course, 'new' diseases resulting from intensification, but it is obvious that close confinement, with ideal conditions for spread, must give added significance to diseases which are of less importance in extensive systems. It might be thought that vaccines would give all the protection necessary, but this is not the case. No vaccine is 100 per cent effective. Steps must be taken, therefore, in the building design to limit the spread of diseases which will almost certainly appear over a period of time. While the hogg or teg is remarkably free from infection other than contagious pustular dermatitis or Orf, there are several infections which threaten the ewe. For this reason in-lamb ewes should not be confined in large numbers in a single enclosure. This is important in both indoor and outdoor systems when close confinement and heavy stocking is practised. They should be penned in groups not exceeding 15–25 ewes per pen. With this precaution infective abortion, for example, can be confined to a comparatively small number of ewes. At the same time it is important to leave at least two pens empty to deal with infections at lambing time, e.g., colibacillosis. This provision is often most difficult to get accepted, for the stockowner, like nature, appears to abhor the vacuum—or in this case the empty pen! The availability of these pens can save the lives of many lambs.

In addition to this limitation in numbers, it is well worth the trouble to make a careful selection of the ewes for each pen. Gimmers should be penned together to prevent bullying by the older ewes at the feeding trough. Such bullying can result in the victim being undernourished, with the consequent risk of pregnancy toxaemia. Ewes should be penned with due regard for their lambing dates. If this is done, the births in any one pen will take place over a comparatively short period of time, thus preventing the build-up of infection which can be so dangerous for the new-born lamb. Though this should not require emphasis, the provision of adequate trough space is of utmost importance. The amount of space varies with the size of the ewes and their stage of pregnancy; the space which appears adequate two months before lambing may be very cramped at full term. The result of inadequate

trough space is again disease in the weaker or less-aggressive ewes. The need for care in the selection of ewes varies to some extent with the breed, being of greater importance in the more active and aggressive hill sheep than in, say, Dorset Horns.

Ventilation

Ventilation is perhaps the most important part of housing from the health aspect. Sheep are peculiarly susceptible to pneumonia, and while viruses and other micro-organisms are usually associated with the disease, there is no doubt that ventilation plays a very important part in its control. This is not to deny the existence of specific infectious pneumonias, which can appear even in well-ventilated buildings. But where ventilation is faulty, this disease is certain to give trouble. The principle at which one should aim is adequate ventilation above sheep level, with freedom from draughts at sheep level. The presence of draughts is usually accompanied by areas of stagnant air. These areas, where the animals will tend to congregate, are the real danger and it is probably better to err on the side of over-ventilation. For this reason adaptation of old buildings requires great care and it is with such improvised housing that the majority of problems arise. Expert advice should always be taken before adapting existing buildings.

Specific diseases

Perhaps the most important group of diseases affecting the pregnant ewe are those causing abortion. In Britain, the common types are vibriosis, enzootic abortion and probably toxoplasmosis. Vibriosis and enzootic abortion can cause very severe loss when ewes are managed intensively, but with housed animals, the precaution of penning in small numbers has proved successful in controlling its incidence within the flock. It is more difficult with animals outside, but an effort should be made to manage these ewes in groups made up from expected lambing dates. Vaccination against vibriosis has not been adopted in this country but if the present trends towards intensification develop, this will require careful consideration. Enzootic abortion is very widespread and vaccination is recommended. It is, of course, of great importance that the cause of any abortion which occurs is accurately diagnosed so that appropriate control measures can be instituted. All deaths should be treated seriously. Many will be casual, but early recognition of a particular syndrome may save considerable loss. Unfortunately, we do not know enough about toxoplasmosis to formulate any control policy at present but again measures aimed at preventing free spread of infection should be helpful.

Colibacillosis and navel infections

These two conditions are very common under intensive conditions and the build-up of infection can be very rapid, particularly when limited numbers of lambing pens are used. In the case of colibacillosis, which is similar to scour in new-born calves and pigs, lambs rarely scour; they die after a short illness characterized by lassitude and collapse. Fortunately, it is fairly easily controlled by antibiotic therapy. The choice of antibiotic requires careful prescribing and it is essential that this is done by the veterinary surgeon. Haphazard use of antibiotics may do more harm than good. To prevent navel infections the umbilicus should be dressed in every lamb.

In both diseases, the removal of the unlambed ewes to the clean spare pens when trouble is encountered will often arrest the condition without resort to medicine. These troubles are most likely to arise where the lambing extends over too prolonged a period—hence the emphasis on 'grouping'. Infected pens should not be used again during that lambing.

It can be seen that, from the point of view of disease control, well-planned indoor lambing can offer certain advantages over intensive outdoor systems, where the significance of such problems tends to increase with the degree of intensification. Again, precautions should be taken before disease appears, as this will reduce the risk and losses very appreciably. Lambing fields should, for example, be divided into two and only one half used for the first half of lambing. The other half can be brought into use if disease appears amongst the lambs or when the halfway mark is reached in the lambing. The conditions mentioned above should give some idea of the type of infection favoured by close contact and illustrate the lines on which its prevention and control may be approached.

Vaccination

As well as vaccination against enzootic abortion, other vaccinations are probably advisable, e.g., against the anaerobic infections such as black-quarter and black disease and possibly pneumonia. These should be discussed in detail with your veterinary surgeon.

Nutrition

So far, nutrition has not been mentioned except for a reference to its significance in the causation of pregnancy toxaemia or twin lamb disease. However, most intensive systems necessitate the use of concentrates at some time, and it is important to realize that sheep can easily be killed by lack of attention to this aspect. Pulpy kidney disease resulting from a sudden increase in the nutritional level is, of course, widely appreciated. What is not always recognized, however, is that vaccines, if they are to protect the animal, require two injections at an interval of one month. The condition must, therefore, be anticipated in time to carry out a vaccination programme. In an emergency, antiserum must be used.

Too-sudden access to barley may lead to losses from acidosis and acute pasteurellosis. This can be controlled by careful rationing and the addition of roughage to the concentrate feed itself, e.g., 10 per cent oat hulls and commercial 'change over' rations are suitable. Sheep on concentrate feeding are peculiarly susceptible to copper poisoning. This element is a cumulative poison and concentrations of as little as 17 parts per million have resulted in poisoning after being fed for some months. Minerals fed to sheep should not contain copper unless specially prescribed by a veterinary surgeon. Finally, all dietary changes should be gradual.

No account of disease associated with intensification could omit some mention of intestinal parasites. Worms have long been a severe limiting factor in sheep husbandry. However, many of the new drugs are highly efficient and, if properly used, they should enable this problem to be satisfactorily controlled. One word of warning should be given on the subject of turning out lambs which have been reared indoors. These animals are not generally infested with the parasites and so have no immunity. If they are put on to contaminated pasture, the build-up of infection may be rapid and disastrous.

Prevention is best

Other systems of management have their own problems, e.g., hypomagnesaemic tetany, but these would require a long article on their own. Each system needs careful individual examination and planning, and a major aspect is that the plan must include provision for keeping the flock healthy. It is a sound investment to apply the principles of preventive veterinary medicine right from the start. Attempts to put these into effect after disease has struck can be difficult and costly.

The author of this article, **J. A. Watt, Ph.D., B.Sc., M.R.C.V.S.,** is a Senior Veterinary Investigation Officer in the Veterinary Department of The Edinburgh School of Agriculture, where he has worked since 1946.

Tax in perspective

Ceasing a Business

G. H. Camamile and E. S. Carter

THE reader will remember that at the beginning of a business the taxpayer has the option to have the second and thirds years' assessments based on the actual profits of those years. At the end of the life of a business, if the total of actual profits of the last two income tax years before the year of cessation exceeds the total of the assessments for these years on the preceding year basis, the assessments are adjusted to actual profits. This is to reduce the loss of tax on a cessation, when the profits of a year or more 'drop out' because of the preceding year method of assessment.

Take the case of Bill Jones, who retired from farming on 5th October, 1965. His accounts showed adjusted profits of:

	£
Year ended 5th October, 1962	3,280
Year ended 5th October, 1963	4,428
Year ended 5th October, 1964	7,324
Year ended 5th October, 1965	4,170

Without any special changes the 'normal' assessments would be:

	£
1963-64	
(preceding year)	3,280
1964-65	
(preceding year)	4,428
1965-66	
(cessation period: actual)	
$\frac{6}{12} \times$ £4,170	2,085

This is fine for Bill, but not for the Inland Revenue, because all the profits of the year ended 5th October, 1964, and half those of the last year drop out of the picture. It would not matter if all years' results were about the same, but they are not. In accordance with the rules explained above, the assessments of the last two whole income tax years (and they must be taken together) will be adjusted to actual. The result will be assessments thus:

	£	£
1963-64		
(actual)		
$\frac{6}{12} \times$ £4,428 =	2,214	
$\frac{6}{12} \times$ £7,324 =	3,662	5,876 (instead of 3,280)
1964-65		
(actual)		
$\frac{6}{12} \times$ £7,324 =	3,662	
$\frac{6}{12} \times$ £4,170 =	2,085	5,747 (instead of 4,428)
1965-66		
(actual as before)		
$\frac{6}{12} \times$ £4,170		2,085

Going out of business, therefore, calls for as much care in selecting the date (if this is possible) as is needed in starting up. What is more, it should always be remembered that a change in a partnership counts as a cessation unless all the partners before and after the change elect for the continuation basis to apply. Such an election, signed by the partners, must be sent to the Inspector within twelve months after the date of change. It can be expensive to miss this alternative: once again, it pays to be up to date.

(This is the fifth note in the series 'Tax in Perspective'. A sixth note will appear in next month's issue of *Agriculture*)

Milk and Milk Products in the Common Market

D. R. Silvey

In 1963, milk and milk products formed about 20 per cent of agricultural output in the European Economic Community. This is a share of considerable importance and comparable with that for this country. The contribution to national agricultural output made by these products varied from member to member but was between 19 and 26 per cent in all countries except Italy, where it was down to 10 per cent.[1] Production of cows' milk in the same year is shown in Table 1 and amounts to over fourteen thousand million gallons, about five times as much as in the United Kingdom. The contribution made by each country to total output varies greatly. France produces 38·5 per cent, West Germany 31·5 per cent, and the other four countries supply the remaining 30·0 per cent. Production has increased by 45 per cent since 1950, and though some countries have shown decreases recently, these are of too short a duration to indicate any established downward trends. In any case, output in the two largest producers, France and West Germany, is still rising. The average quality of milk in the Community, as indicated by the butterfat percentage, is similar to ours. It varies appreciably from member to member, however, being highest in the Netherlands at 3·83 per cent and lowest in Belgium/Luxembourg at 3·45 per cent.

In the Community there are twenty-two million cows of dairy type, in addition to draught animals. Nearly ten million of these dairy cows are in France (44·6 per cent) and nearly six million in West Germany (27·1 per cent), as indicated in Table 1. The cow population in both these countries is considerably higher than in the United Kingdom, which has something over four million dairy and beef cows.[2] On the other hand, yields per cow

[1]Agricultural statistics from different countries are not always in a form which enables direct comparisons to be made. As far as possible comparable data have been used in this article but the figures are intended to illustrate relative rather than absolute differences.

[2]About three-quarters of these are classified as dairy cows in British statistics. They would probably all be termed dairy-type cows in the Continental sense.

are not particularly high in the Community, averaging 642 gallons by comparison with the British national dairy herd figure for 1963 of 770 gallons. However, individual national averages exhibit a wide range. The Netherlands and Belgium/Luxembourg are highest with 872 and 809 gallons respectively. West Germany comes next with 747. France, with the largest number of cows, has a very low figure indeed (only 555 gallons), and Italian yields are at much the same low level as the French.

TABLE 1

Milk production, quality, dairy cow numbers and yield per cow

1963

	Belgium and Luxembourg	*France*	*Italy*	*Netherlands*	*West Germany*	*E.E.C.*
Milk production (million gallons)	892	5,413	1,832	1,498	4,422	14,057
Distribution of total production (%)	6·3	38·5	13·0	10·7	31·5	100·0
Butterfat (%)	3·45	3·75	3·60	3·83	3·79	3·73
Dairy cows (million head)	1·1	9·76	3·38	1·72	5·92	21·88
Distribution of cows (%)	5·0	44·6	15·4	7·9	27·1	100·0
Yield per dairy cow (gallons)	809	555	542	872	747	642

Utilization and consumption

In contrast to its utilization in this country, most of the milk produced in the E.E.C. is for manufacture. About 40 per cent of total output is made into butter, 14 per cent into cheese and 6 per cent into other dairy products. Only 25 per cent is consumed as liquid milk or cream and the other 15 per cent is used on the farm as stockfeed. In this country some 66 per cent of total production from the national dairy herd is consumed in liquid form, the remaining 34 per cent being utilized mainly for manufacture. Annual consumption of liquid milk per head is 32 gallons in Britain but averages only 20 gallons in the E.E.C. The Netherlands has the highest consumption per head in the Community, with a level similar to ours, whereas in Italy consumption averages only 14 gallons per head.

The E.E.C. as a whole is almost self-sufficient in production of butter and cheese, the two most important dairy products, and some member countries produce a surplus. The situation in Britain is very different since we import about 90 per cent of the total butter used and 55 per cent of the cheese. Table 2 shows the situation over the period 1960–61 to 1962–63 for each member country and for the whole Community. Production is shown as a percentage of consumption. A figure of less than 100 per cent indicates the extent to which the country is dependent on imports. A percentage of over 100 shows to what degree it is an exporting country. All countries except Italy and West Germany are net exporters of butter. The Netherlands, for example, exports a quantity equal to 61 per cent of her consumption. So far as cheese is concerned, Belgium/Luxembourg shows the lowest degree of self-sufficiency, producing only 47 per cent of total requirements. The Netherlands, on the other hand, exports a higher proportion of her total production than any of the other countries, retaining less than half for internal consumption.

TABLE 2

Production as a percentage of consumption 1960-61 to 1962-63

(net of imports and exports)

Country	*Butter*	*Cheese*
Belgium/Luxembourg	107	47
France	110	105
Italy	73	94
Netherlands	161	217
West Germany	94	77
E.E.C.	97	99

Dairy policy in the Community

A common dairy policy was agreed in February, 1964, and is now being implemented, though a few aspects are still under discussion. Gradual harmonization of individual policies and prices is taking place so that by 1968 a common policy and price level will apply throughout the Community. Internal prices are controlled by a system of variable levies on imports of milk products from outside countries. A minimum import price (threshold price) is set for the product. If, as is usually the case, world prices are lower than this, the difference is taken as a levy. For the purpose of price fixing, similar products are sometimes grouped together and the threshold price determined for a pilot product only. This price then applies to all the items in the group. Such a scheme is operated for certain cheeses, for example. The threshold price is set at a level which will not allow imports to be placed on the market at a lower price than that aimed at for home-produced supplies. During the current transitional period, when the price level of a particular product may differ from member to member, the threshold prices in each country are adjusted to make imports from other Community members more attractive than those from third countries.

Until 1968, when a common price will be in force, individual ex farm target prices are being established annually in each country for standard quality milk with 3·7 per cent butterfat. These are used as a basis for the calculation of producer prices, payment varying according to quality. In 1964–65, the target price in each country was decided with reference to the quoted national average price in 1963 (the reference price) but had to lie within the range 32·0 to 42·3 pence per gallon. The width of the range is being reduced annually so that by 1968 the common target price will apply to all members. The prices chosen for 1964–65, 1965–66 and 1966–67 are shown in Table 3, along with the 1963 reference prices. The common target price to operate from 1st April, 1968, is equivalent to 39·3 pence per gallon.

TABLE 3

Producer prices for milk

(ex farm and excluding subsidies)

Pence per gallon (3·7% butterfat)

Country	1963 (reference price)	1964-65 (target price)	1965-66 (target price)	1966-67 (target price)
Belgium	33·0	38·2	39·8	39·8
France	32·5	32·3	34·5	36·7
Italy	38·4	41·9	41·5	41·5
Luxembourg	38·9	40·0	40·0	40·0
Netherlands	32·8	34·6	35·7	37·2
West Germany	37·7	38·0	38·3	38·3

The target price is not a guarantee to producers but an objective. After 1968 it will not be possible to use direct commodity subsidies to support prices, although this is permitted at present. Nevertheless, by setting what are, in effect, guaranteed minimum prices for butter (intervention prices), some control of internal price levels can be achieved. Butter manufacture does, after all, account for 40 per cent of the total milk produced. Purchasing agencies set up by the member Governments must take all the butter offered to them at the intervention price. If necessary, accumulated supplies can be exported in order to maintain home prices. These exports will normally be subsidized from Community funds provided by the import levies and by Exchequer contributions from the member countries.

Provision has been made to allow control of imports by methods other than the establishment of threshold prices. These include licensing restrictions, minimum quality requirements and the power to suspend imports entirely.

The future outlook

The level at which the common target price is fixed is one of the major factors which will decide the future production, consumption and trade patterns of the Community. Over the past few years the average target prices have been at much the same level as the average prices paid to producers in this country. Future target prices show slight increases over current levels, which seem rather high when it is remembered that so much of the milk produced in the Community is manufactured. However, there are many small-scale producers in the Common Market who, because of their political and social importance, have played their part in securing high prices. In the longer term, adjustments may be made in the price level as part of the Community policy to reduce the number of small-scale producers, but sudden large price reductions are unlikely for social and political reasons. In the short run, therefore, price levels will probably remain high.

A great deal depends upon the profitability of milk production compared with other activities but the common target price of 39 pence is likely to stimulate production in some member countries. This applies particularly to France which had the lowest producer price for milk in 1963, as shown in Table 3, and where present yields per cow are exceptionally low, apparently leaving considerable room for improvement. The net result is expected to be an increase in milk output from the E.E.C. as a whole, despite possible decreases in individual countries. The level of milk solids consumption within the Community is already high and is not expected to keep pace with the rise in output. Surpluses are, therefore, expected. Estimates made by the Food and Agriculture Organisation in 1963 indicated that exports of butterfat from the Community are likely to rise from thirty-one thousand tons in 1958 to nine times that amount by 1970. An important problem for the E.E.C. in the future is likely to be the development of new export markets for dairy produce. This will, of course, intensify the problems of third countries seeking to export similar products.

This article has been contributed by **D. R. Silvey, B.Sc. (Hons.), Dip.Agric. Econ.**, who is a Research Officer in the Farm Economics Branch of the School of Agriculture, Cambridge. He is particularly interested in the European dairy industry.

Grain Drying and Storage

This feature on a topical subject contains articles by

★ **P. H. Bailey, B.Sc. (Engineering), M.I.Agr.E.**, who is a Principal Scientific Officer at the National Institute of Agricultural Engineering which he joined in 1943 from King's College, London. He is Head of the Tractor and Drier Testing Department in the Testing Division of the N.I.A.E.

★ **L. C. Couch, A.R.I.C.S., Q.A.I.A.S.**, who is a Senior Assistant Land Commissioner with the Agricultural Land Service. Before entering the Ministry in 1959, he was with a private firm of land agents which he joined after leaving the Royal Agricultural College, Cirencester.

Grain Drying

P. H. Bailey

Is drying necessary?

At the 1964 machinery census there were about 27,000 farm grain driers, that is, about one drier to every two combine harvesters. If some combines can get along without the backing of a farm drier, why do so many farmers go to the trouble and expense of drying their grain? The moisture content to which grain must be reduced for safe year-round storage at ordinary ambient temperatures, 14 per cent, is less than the optimum for most uses to which the grain is put, and removal of water reduces the weight of grain for sale.

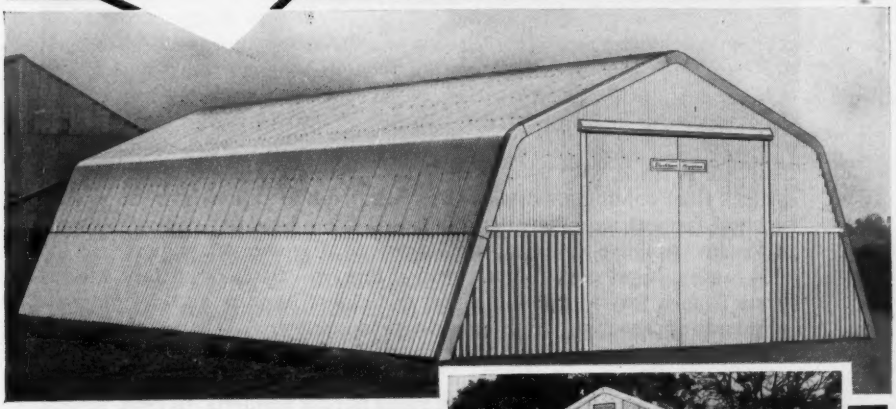
The pioneers of combine harvesting in Britain assumed the need for a drier, but as the number of combines began to swell during the 1940s, farm drying facilities lagged behind until 1950 when there was only one farm drier for every seven or eight combines. Much of the grain was harvested sufficiently dry to keep, in sacks, without drying; some was dried by purchasers with their own drying facilities, or by co-operative or government-sponsored grain stores; and some suffered serious deterioration. Market pressures reflected the shortage of drying capacity, and for a few years installation of a drier and storage capacity was obviously sound sense: by 1956 the combines per drier figure had fallen to four. With the current price structure, designed to promote orderly marketing, there is still incentive to store grain on the farm in a form which allows some flexibility of disposal, i.e., dried to the safe bulk storage moisture content, provided that the costs of drying are not unduly high.

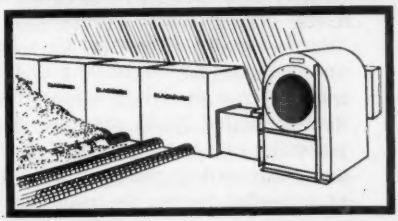
Alternatives to drying

On purely economic grounds, further expansion of farm grain drying capacity might be strictly limited, but possession of some means of dealing with damp grain must increase the confidence with which a cereal grower, even in a low-rainfall area, can face the harvest: in fact, the true economic assessment of a grain drier should perhaps include an allowance for its value as insurance against disaster. Although the increasing use of sealed storage for damp grain provides an attractive alternative to drying, it is only appropriate for grain retained on the farm, or sold nearby for stockfeed. As chilled storage of grain emerges from the experimental stage, it seems likely that chilling will more often be an adjunct to drying (to permit storage at rather higher moisture levels) than an alternative. The availability of combine harvesters of larger and larger working rate theoretically reduces the need for drying, as such machines reduce the probability of having

This way grain-drying pays...

—a store which requires little or no maintenance and cuts the cost per ton of grain stored—the most practical (and economical) ducting and laterals on the market—a fan/heater which is exactly right for the job (no waste of power or money), plus experienced advice and assistance to ensure that you get just what you need—at the right price. And you deal with one supplier only.





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to harvest at excessive moisture contents; but they usually find their way to farms already equipped with driers. Yet further expansion of grain drying is likely to be on the farms of the smaller growers.

Types of drier

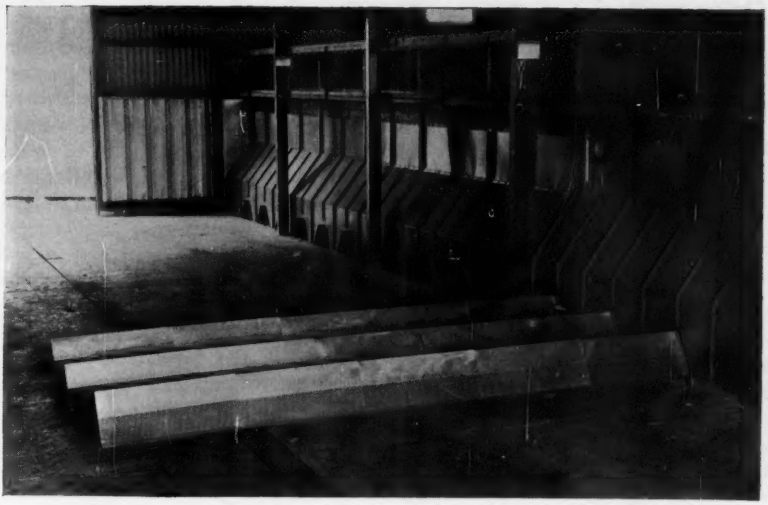
There is a bewildering choice, not only of makes of driers, but of drying systems available to the farmer. Being used on average perhaps less than 200 days in a ten-year period, to have any chance of economic viability a farm grain drier must be low in capital cost per ton of grain handled and have a low labour requirement; fuel costs are of secondary importance. Therefore almost all farm driers are technically simple cross-draught bed driers, using hot or slightly warmed air. More complex machines, which are economic in continuous industrial use, or for special purposes, have been proposed for farm grain drying from time to time but have not proved economically practicable in agriculture.

Current types of drier can be classified as continuous-flow, batch, and storage driers. Continuous-flow driers, scaled down and simplified from flour mill practice, were used by the combine pioneers and although simpler systems than continuous drying have been evolved expressly to fit in with practical farming requirements, continuous driers have sufficient advantages to remain attractive at least to the larger cereal grower or syndicate; at the 1964 census, 36 per cent of driers were of this type. Batch driers take various forms from a tray to a combination of holding hoppers and drying compartments approaching continuous driers in complexity. The simple in-sack platform drier, developed for farm use in the days of the bagging combine and usually built largely by farm labour, with only fan and heater unit bought in, has been eclipsed with the swing to bulk handling. In 1964, in-sack driers and tray driers each accounted for 14 per cent of the total number, with indications that the number of sack driers was decreasing rapidly. Batch driers were on the increase, apparently on smaller farms.

In continuous-flow and batch driers, grain is dried before storage. In storage driers, it is dried after being put into store, so handling is minimized. Storage driers, which are suitable for all sizes of farm, fall into two categories, i.e., in-bin driers and on-floor driers. Both use air warmed only a few degrees above atmospheric temperature, which in the bin type of drier is usually distributed by a permeable floor or a vertical central duct, and in the on-floor type by a system of ducts laid on the floor. Drying proceeds over a period of several days in all types of storage drier, and in duct-ventilated grain, complex drying patterns are set up which call for particular care in management to obtain a satisfactory result. Provided, however, that airflow rates are adequate, that the relative humidity of the air is controlled to give the optimum final moisture content, and that drying is continued long enough to eliminate all damp patches, storage driers are intrinsically safe in their treatment of grain.

Drier control

In continuous-flow and batch driers using heated air, in order to ensure safe treatment of the grain the hot air temperature must be limited to values depending on the use for which the grain is destined. The scales of critical grain temperatures for seed and of limiting hot air temperatures for various



On-floor drier before harvest, with three lateral ducts in position

grains, published originally in *Agriculture* in 1942 and 1944 respectively, are still in use for these types of drier with only minor amendment. The latest version of the hot air temperature scale, as given in the 1966 edition of the Ministry of Agriculture's Bulletin 149, *Farm Grain Drying and Storage*, which is a useful source of information on most aspects of the subject, is as follows:

Grain and purpose	Max. air temp. °F
Grain for stockfeed	180–220
Wheat for milling	150
Malting barley and seed corn up to 24 per cent m.c.	120
Malting barley and seed corn above 24 per cent m.c.	110
Oily seeds	115

Particular stress should be laid on the limit for milling wheat: a recent survey of the use of continuous driers in practice showed that, while other limits were observed, there was a tendency to use excessive temperatures in drying milling wheat. It is not always realized by farmers that the gluten in wheat is damaged by overheating, and the survey results suggest that millers' criticism of some farm-dried wheat is not without justification.

Hot air temperature in continuous and batch driers is almost invariably thermostatically controlled, or made subject to high limit control. Supplementary heat in storage driers is sometimes switched on by a humidistat, and this gives control of final moisture content. Automatic control of output moisture content in continuous and batch driers will be welcomed by most farmers provided the capital cost is not excessive, and systems based on direct electronic sensing of output moisture content and on measurement of exhaust air temperatures are passing from the experimental stage to become commercial propositions. Automatic control of moisture content in continuous driers will be the final link in electrical control systems which already provide a high degree of automation in electrical interlocking of the drier and its ancillaries to ensure satisfactory running with the minimum of attention.

Drier ancillaries

In a fixed installation of continuous or batch driers, a conveying system of bucket elevators and belt or chain-and-flight conveyors gives the greatest economy in terms of weight of grain times distance conveyed per unit of power used—and therefore in terms of installed electrical power. However, though more expensive in power, portable auger conveyors of $3\frac{1}{2}$ in. to $4\frac{1}{2}$ in. diameter, and the larger 'carriage-mounted' augers, have revolutionized the bulk handling of grain in storage driers and the simpler continuous and batch drying installations because of their low capital cost and general handiness.

With the general use of selective weed-killers and the good cleaning ability of modern combines, grain precleaners are perhaps no longer essential for all types of drier, but may still be considered desirable. Dust and chaff are still present to some extent, and can impair the effectiveness of continuous and batch driers, and give rise to local damp patches with consequent heating in storage driers.

Finally, even if a drier incorporates automatic control, a moisture meter is essential to the proper control of the drying process. Most commercial moisture meters claim an accuracy of $\pm\frac{1}{2}$ per cent but these limits are in fact only obtained on a proportion of samples tested under farm conditions. The most accurate instruments are those which are almost in the class of laboratory equipment, and are perhaps more delicate and fiddling than farmers wish to use. A satisfactory degree of accuracy combined with quick reading can be achieved with various types of moisture meter measuring electrical properties of grain, and other types can also give satisfactory results if properly used. No meter can give an accurate indication of the moisture content of a bulk of grain without adequate and careful sampling, and ultimately it lies in the hands of the user to ensure that his grain is economically reduced to a known optimum moisture content.

Choice of drier

Before installing a new drier, a farmer would do well to consult his N.A.A.S. Mechanization Adviser and the Agricultural Land Service, and read the relevant parts of Ministry Bulletin 149, *Farm Grain Drying and Storage*. A British Standard, No. 3986: 1966, has recently been published giving methods of test for agricultural grain driers. This is being used by the N.I.A.E., and drier ratings are already being published in accordance with the Standard. In buying a new drier, it is an obvious precaution to inquire the B.S. rating: if manufacturers are always asked for the rating by prospective purchasers, they will make sure that it is available.

Storage of Grain on the Farm

L. C. Couch

WHY store grain? The simple answer is to obtain, as far as possible, the advantages of a seller's market. If this were not so, a high percentage of the grain grown for re-sale would be sold, if it were at all possible, at harvest, before it ever entered a granary or store. Even this system could lead to storage difficulties for the merchant who may well insist that the farmer stores it, with or without an additional premium. When grain is grown for consumption on the farm, then it must be stored on the farm. It would be unwise to sell at harvest when the price may be low and re-purchase in winter and spring when the price is normally correspondingly high. Apart from the actual storage of grain, there is the need for conditioning prior to or during storage. It should be remembered that, to keep grain in bulk satisfactorily, the moisture content should be between 14 and 16 per cent.

Factors of importance

There are many factors which should influence the choice of a storage and conditioning system. The main ones are:

(a) Size and type of farm; the quantity and variety of grain grown; the ratio of the amount to be sold off and that to be kept on the farm for processing and feeding.

(b) Number of types and varieties of grain grown and the rate of combining, coupled with the rate of flow from the field to store at harvest.

(c) Sale outlets. The grain grown may be for seed, malting or feed; its individual treatment in the store can be quite varied.

(d) Reduction of peak labour demands. On a farm where labour is scarce and grain is flowing quickly into the store, it is essential that handling is quick and kept to the minimum.

(e) Minimum capital outlay. This is most important; every £100 of capital outlay means that a considerable annual charge is levied on the farm in terms of interest, amortization and depreciation.

(f) Period of storage. Usually some grain is sold off at harvest. The remainder and bulk of the grain can then be stored for as long a period as possible to obtain the highest possible prices and incentive payments.

(g) Future developments. Where possible, some flexibility should be allowed for expansion and change of methods.

(h) Suitability of existing buildings or storage system for adaptation.

All these factors are interrelated and no single one should be considered in isolation. For example, the choice of a system with a very low labour requirement can often lead to such a high capital cost that the advantages are cancelled out.

There are various types and methods of grain storage and conditioning systems, ranging from the traditional in-bin system with a continuous-flow drier to a single moist-grain silo which need not even be of a permanent nature. Apart from seed, grain is either used as stockfeed or sold for milling or malting. Both outlets can be satisfied by similar storage treatment and conditioning, but feed corn does not necessarily require drying and has the advantage that it may be stored and fed moist.

Systems of grain storage

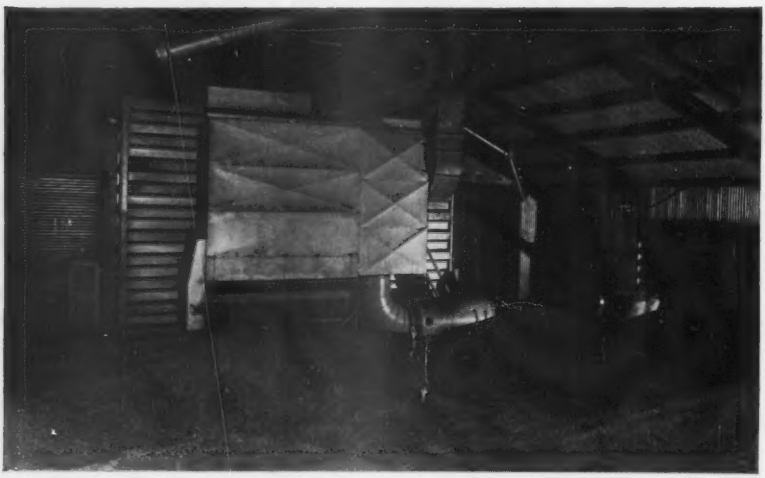
There are, basically, eight different systems of grain storage, which may be described as follows:

In sack. This is generally considered out of date: there is a high labour requirement for reception and disposal. Grain is kept in very good condition with the minimum of treatment. Risk of attack from rats and mice is high. The cost of purchase or hire of sacks can also be high.

On floor (*continuous drier*). Cost is in the region of £13–£18 per ton. Labour demand during harvest is low, but it may be high when grain is removed according to the extent of mechanization employed. The building has a general-purpose function. This factor should not, however, be given too much importance as it is likely to be required for grain for many years. Even if it is emptied by the year end, the housing of stock in it is hardly desirable or even practical.

On floor (*dried in situ*). Cost is in the region of £12–£14 per ton and is about the cheapest method of permanent bulk storage for grain if a new store is erected. The cost may be as low as £10 per ton if a very large store is erected.

On-floor continuous drier



GRAIN STORAGE

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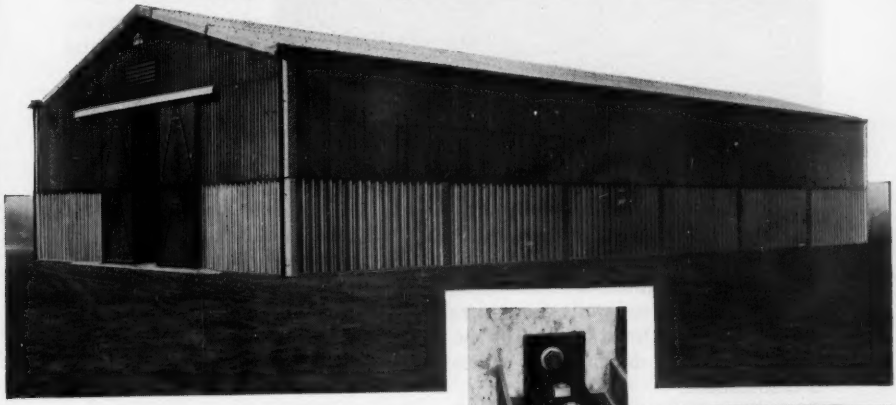

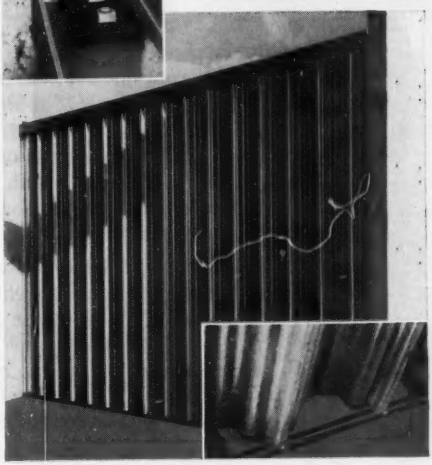

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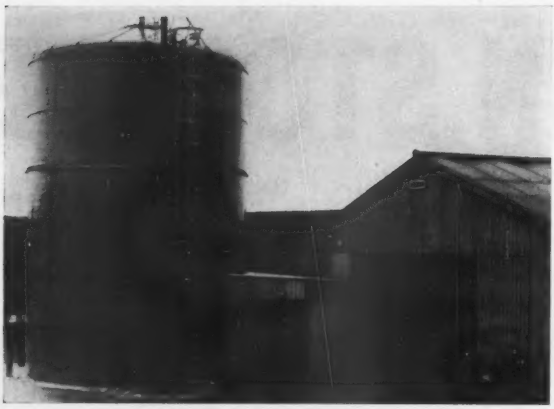


A moist grain silo—sited close to the mixing unit and cattle yard

This is a very similar system to the second one, the main difference being in the method of drying and conditioning. This is carried out on the floor by means of a main duct and laterals. In the case of both the second and third systems, the external walls should be constructed in such a way that they will resist the lateral thrust exerted by the grain, which can be considerable when stored over 3 feet deep. Expert advice should be sought before building work is commenced.

In bin with continuous-flow drier. This is, without doubt, the best system of conditioning and storing grain related to labour saving and control of drying. The cost can, however, be prohibitive, ranging from £22 per ton for the larger arable farm to £35–£40 for the medium or smaller-sized farm. Push-button control is possible, resulting in easy movement of the grain from one part of the store to another without handling. Various types of grain can be stored separately with individual control. The installation may be housed in an existing building or a new one. This is a specialized installation in a specialized building which does not have a general-purpose function.

In bin (*dried in situ*). This is considered, generally, to be as good a system as the fourth one. The cost is slightly lower on average, i.e., in the region of £18–£30 per ton. Many of the advantages of the previous system described can be attributed to this one; it is equally adaptable for push-button control. The method of drying can be achieved by blowing warm air through the grain by means of a central cylinder or a ventilated floor. Timber and steel bins are available in various forms.

Outdoor ventilated bins. The cost is in the region of £14–£18 per ton, i.e., between the cheapest and more expensive. For the small and medium-sized farm this system is ideal. The main disadvantage is the fact that most of the operations have to be carried out in the open which can cause some difficulty and inconvenience in a very wet harvest. A temporary cover for the reception area or pit is recommended. Possibly the worst conditions are experienced during winter when the bins are emptied.

Sealed grain silos. This is a method of storing grain by the exclusion of oxygen and preservation by the carbon dioxide evolved. It will accommodate grain direct from the field at a relatively high moisture content, though it is not advisable to store grain with a moisture content over 25 per

cent. Above this moisture content toxic moulds may occur which could have an adverse effect on animals. The cost is very low, in the region of £9–£14 per ton according to the capacity of the silo and the strength of foundations required. However, the grain stored is only suitable for stockfeed. Once taken from the silo, the grain only stays in good condition for a few days. This system is easy to manage and, with the help of a high-powered blower, silos are quickly and simply filled. The grain has proved very palatable and digestibility is improved. The silos should be sited in close proximity to the processing plant to enable the grain to be easily conveyed from outlet to mill hopper.

Chilled grain. This is adaptable for silo or on-floor storage and in almost any existing building where grain can be stored. The cost is variable but on average it is similar to the medium-priced more conventional systems, i.e., in the region of £10–£25. Grain is stored as harvested and may be fed to stock whilst moist. It can also be processed at any time of the year for milling, malting, seed or feed, thus lowering the demand on peak labour times. Careful control is necessary to achieve the correct temperature. For example, at 40 degrees, moisture content should not exceed 22 per cent. Several refrigeration companies offer chilling units consisting of a refrigerator/fan combination with necessary control gear.

Cost

In addition to the capital cost of a grain store, the annual charges must be studied very critically. These are:

(a) Rate of interest charged on capital.

(b) Cost of a sinking fund to regain the capital over a specified period of years, i.e., 10–20 years according to the equipment installed.

(c) Cost of labour, which must be kept to a minimum.

(d) Power and fuel costs.

(e) Building repairs, insurance and machinery maintenance.

Infestation

Many problems of infestation by rats, mice, insects and mites can occur in bulk grain stores. There are various methods of control and eradication; the main point to consider is the accessibility of plant and equipment for cleaning and fumigation. This is, however, too specialized a subject to be dealt with in this article.

Summary

If you are considering improving or providing a grain storage system on your farm, study the basic problem and examine whether there is an economic need for alternative grain storage. Your existing arrangements may be sufficient with some modifications. If a new scheme is decided upon, this can be a complex problem. Give it plenty of thought and allow sufficient time for all the details to be collected in order to obtain Farm Improvement Grant. Call in expert advice, as soon as possible; the Agricultural Land Service and National Agricultural Advisory Service Mechanization Adviser are always available to give you assistance before you proceed further with detailed plans and estimates.

Dutch toolbar ploughing acid peat over silty sand. Furrow slice of peat and silty sand cocked to angle of 135 degs.

Dutch Soil Amelioration Machinery

P. E. Cross

The machines described in this article were seen at work in the Netherlands in October, 1965, by a study group, members of which were Dr. A. N. Ede, Land Drainage Experimental Unit, Cambridge, Mr. T. H. Caldwell, Soil Scientist, Cambridge, and the author.

IN the Netherlands, the development of machinery and equipment capable of dealing with soil amelioration problems posed by the reclamation of new polder areas and also in connection with re-reclamation schemes in the old cut-over peat soils lying to the west of Lake Issel (Zuider Zee), has been the subject of intensive study over the past 20 years. Previously, the use of very large single-furrow trailed ploughs on the reclaimed polders was fairly well understood, in that they were used either to bare or bury soil fractions in the upper profile according to need. One or two of these so-called polder ploughs were imported into Britain before the war and were used in the reclamation of the salt-marshes around the Wash.

Old peatlands

Since the war new polder areas have been opened up and others are in course of construction, but it is to the old peatlands that the Dutch have

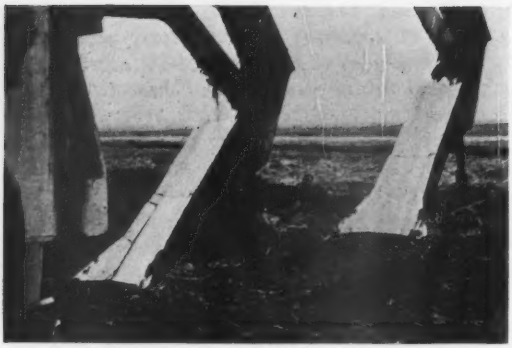
been turning much of their attention. The re-reclamation of uneconomic fragmented holdings as a result of voluntary or compulsory acquisition is providing testing facilities for machines of new conception, especially in the treatment of 'disturbing layers' within root range of cultivated crops. Unlike our fen basin peats which consist largely of rush, reed and sedge residues overlying silt and clay deposits laid down under alkaline conditions, the Dutch peats are derived mainly from sphagnum moss and sedge residues overlying very acid dune type sands. It is obvious therefore that from a mechanical, chemical and biological standpoint Dutch peatland amelioration problems are entirely different from our own. They are concerned with means by which an intensely acid and wet impermeable layer of peat below the topsoil can be drained, aerated and limed to provide for an adequate rooting environment. Conversely, our problem is the rapid loss of peat which may lead to unwelcome changes in the pattern of farming resulting from the inevitability of our having to farm a mineral soil.

'*The fate of the black peat fens is sealed. As long as they are drained and cultivated they will produce richly, but in producing die. The peat, a wasting asset, is drained and farmed only at the cost of its ultimate and inevitable destruction.*' *The Black Fen*—A. K. Astbury. How far these changes can be arrested depends on measures which can be devised to conserve some portion of our peatland residues whilst there is time, and in so doing, how best we can phase the change-over to a gradually increasing mineral fraction without affecting productivity. It is in this field of study that we shall need to look at non-conventional machines which may be adaptable or used for soil phasing experimental and developmental work under our conditions. Heavy machinery contractors in the fens are beginning to think in terms of continental machines, so it is quite appropriate to discuss them here. Apart from the original single-furrow polder plough, the machines now being used and developed are the toolbar plough; the broad rooter; the slip plough and the rotary mixer.

Toolbar ploughs

Toolbar ploughs are a more recent development of the polder plough, but instead of being trailed they are mounted on to hydraulically-operated linkage attached to crawler tractors and controlled by an operator seated on the plough. They are more suited to work on soft peatlands, there being no carriage wheels to sink into the ground and so affect depth regulation. Another advantage is reduction in length and a reduced turning arc. In normal work two D7-type crawler tractors are needed to turn a single furrow about 3 ft wide and upwards of 4 ft in depth. The toolbar plough is designed to lay a furrow slice at an angle of 135 degrees, thereby creating a sequence of peat-cum-subsoil materials (see illustration on page 35).

Although toolbar ploughs are efficient in the work, they do suffer from very substantial disadvantages. The first is the volume of excavation and infilling which must precede and follow the use of a deep plough. The second is the amount of bulldozing required to level off the deeply-ridged furrow slices before normal tillage operations can begin. In themselves these operations are costly, whilst four or five passes by bulldozers lead to considerable reconsolidation of the subsoil with consequent loss in drainage efficiency.



Van Damme mounted broad rooter

The broad rooter

The broad rooter is a development of the pan buster, the difference being that the broad rooter is designed to mix a proportion of the subsoil material into the cultivated layer and also to deposit a moderate cover over the surface of the land. It is, in fact, a mixing subsoiler. The pan buster shatters the subsoil layers but leaves them in the same position relative to the topsoil.

Basically, the broad rooter consists of a wheeled or tractor-mounted carriage on which is carried a pair of spud-shaped shoes fixed to massive shanks at an angle of 45 degrees. The original models were wheel-mounted and these are still in use on the mineral soils of the polders, but on soft peat soils the land wheels tend to sink deeply into the surface when under load. The later models for fen use are mounted on wide-tracked crawler tractors. The hydraulically-controlled spud-like blades are staggered and at speeds varying between seven and ten miles per hour the mixture of peat and subsoil materials 'boils' to a height of three to four feet around the blades and so accomplishes a fair degree of mixing. The machines are capable of working to a depth of 4 ft, the work output being in the region of 10 acres per day at a cost of £32 per acre[1]. Levelling is effected by means of a heavy baulk of timber drawn at right angles to the work. Normal tillage operations and liming can proceed as soon as the surface is dry enough to crumble. The machine illustrated above was photographed at work on a farmer's holding adjacent to the Borgercompagnie Peatland Experimental Station and was being drawn by three crawler tractors totalling nearly 500 h.p.

The slip plough

The slip plough, not unlike the broad rooter in action, was also seen in operation by the study group. It is a crawler-mounted single-bladed machine, fitted with an adjustable spud mounted at an angle of 30 degrees which is connected to an upwards-sloping dished channel about 12 ft in length. In use the subsoil materials slide up the sloping channel and are spilled over on to the soil surface as well as being mixed into the profile. The machine works to a depth of 2½–3½ ft covering about 5 acres per day at a cost of £32 per acre[1]. Two large crawlers were needed to power the unit under

[1]Agricultural Newsletter from the Netherlands—May, 1966.

normal October conditions and, compared with the double-spudded broad rooter, the work appeared to be slow. There seemed to be no reason why the machine could not be fitted with two spuds and so approximate the broad rooter on rate of work. Under the conditions operating at the time, the boiling action of the disturbed layer was not so obvious as with the broad rooter. It seems that the two machines are similar in mode of action with the accent on the broad rooter for mixing and speed of work.

The rotary mixer

Whatever the accomplishments attained by the use of ploughs and mixing subsoilers the soil physicists we met at Groningen and Wageningen were convinced that, in the ultimate, they would be looking for a more intimate mixture of peat and subsoil constituents, possibly down to centimetre-sized particles. With this aim in mind they were looking forward to the development of the Van Agtmaal rotary mixer, the invention of a Brabant farmer whose prototype machine is illustrated on page 36. Basically, the machine consists of a tractor-mounted, hydraulically-controlled rotor with power take-off from the tractor. The rotating drum is fitted with curved blades which break up and mix the profile to a depth of one metre. It was hoped that improved models of the machine could all be mounted on wheeled tractors making them suitable for quick transit between fields and farms. However, experience has shown that to obtain an economic work output spudded rotors upwards of a metre wide must be used and these would be far too heavy and difficult to control behind wheeled tractors.

Developmental engineers are now designing the outfit for attachment to crawler tractors, in which case its cost would preclude its use as a farmer-owned machine. Besides the great advantage of obtaining a very intimate mix in depth, the machine does not require any opening up or closing in works. It is able to work from corner to corner of any field leaving a level, friable terrain for working down into a seed or planting bed when soil conditions permit.

Inevitably, the demonstration of this machine raised discussion on the Fowler gyrotillers which were used in Britain between the wars and which

Features of soil profile after deep ploughing—note alternate layers of peat and silt sand at an angle of 135 degs.

Prototype rotary mixer driven by power take-off from tractor

finished their working operations on the groundnut jungles of Africa. Members of the study group could not help the feeling that given these machines today the vertical contra-rotating cultivators could have been adapted to simulate the work of the present-day Dutch rotary mixers on peat soils.

Two important points

In all our discussions with soil amelioration experts in the Netherlands two facts were stressed. The first is that all deep tillage works must be preceded by a carefully-conducted pedological survey of the potential cultivated zone before any form of deep soil working is planned, and secondly, that any inadequacies in area or field drainage must be rectified before any form of soil mixing is undertaken.

The author of this article, **P. E. Cross, O.B.E., N.D.H.,** was for 20 years County Agricultural Officer for the Isle of Ely, before taking up his present appointment as Farm Director of the Arthur Rickwood Experimental Husbandry Farm, Cambridgeshire, where peat wastage and soil amelioration studies form an essential part of the experimental programme. He has made a special study of changes within the soil profile, peat wastage and soil amelioration both in this country and the Netherlands.

Research Spot

Breeding Better Farm Crops

A. J. L. Lawrence

CONSTANT changes in growth patterns occur throughout the life of a plant. The leaf area changes, so does the root/shoot ratio and the assimilation rate. These may mean very little to the practical farmer but their more intensive study is very likely to be of direct benefit to him in the future. They may, for example, make it possible to breed crop varieties specially suited to a particular combination of soil and climatic conditions.

Long-term research

The coming into full operation, in January, 1965, of the new Stapledon Laboratories and Glasshouses at the Welsh Plant Breeding Station has enabled a start to be made on a long-term programme of research to determine the part played by structural and physiological differences between plants in relation to potential crop yield. Crop yields are closely affected by the relationship between light input and assimilation, and in examining this it is essential to experiment under conditions where light and temperature can be accurately controlled. The new 'growth rooms' at the Station provide this means and enable the newer methods of studying plant growth to be used to complement experiments of a hitherto less revealing nature in the field. Such controlled studies may throw light on many puzzling aspects of plant growth. They may give a direct guide to the type of breeding material that would be of special value for a particular aim, and also opportunities of testing the validity of different plant breeding techniques likely to hasten progress in improving the performance of the farmer's crops.

The Report of the Welsh Plant Breeding Station, 1965, includes a number of points of practical interest, of which a few may be mentioned in illustration. In trials to test the effect, on the establishment of white clover, of inoculation with *Rhizobium* bacteria under high and low levels of liming, establishment was increased by 10 per cent by the inoculation treatment but this effect was overshadowed by that of the high lime treatment, which more than doubled establishment. Nodulation was increased by inoculation but the stimulation of nodulation by the high lime treatment was far greater.

Work on the mineral content of herbage plants has shown that timothy and red clover are low in sodium content. Since these are frequently sown together it is pointed out that there may be a risk of sodium deficiency during prolonged feeding of timothy/red clover hays.

Lodging of cereals

In field trials at Rosemaund Experimental Husbandry Farm carried out in conjunction with the N.A.A.S. and the National Institute of Agricultural Botany, the relation of lodging to the grain yield of three stiff-strawed varieties and two high-yielding but longer-strawed varieties of winter oats were compared. The results indicated that, though the degree of lodging of the longer-strawed varieties might be four to five times that of the stiffer-strawed plants, the yields of the former still exceeded that of the latter. This indicates the delicate balance required in developing new varieties with relatively short stiff straw but still producing maximum yields under a range of conditions. In the words of the Report, at harvest a lodged crop need not necessarily be inferior in yield to a standing crop, though harvesting might present more difficulty.

Adaptability of crops

Trials at Aberystwyth have shown that spring oats are generally the lowest yielding of the cereal crops. However, yields show a wide range of variation and occasionally grain yields up to 50 cwt per acre are obtained. This shows that the crop is sensitive to physical environment rather than fundamentally low yielding. It would seem wise, it is pointed out, in breeding farm crops to keep in mind the need for them to have some degree of adaptability to seasonal variations in climate. Oat varieties are now being tested to ascertain whether there is a physiological basis for these differences.

The adaptability of herbage plants to different levels of mineral nutrition has also been studied in measurements of shoot growth under sub-optimal conditions of mineral nutrition. With under-nutrition, varieties showed considerable variation in the rate of shoot growth but when grown with near-optimal nutrition the variation was very small, all varieties tending to have the same rate of shoot growth. Similarly, in experiments on the recovery of herbage plants from repeated defoliation, when grown at low and at high planes of nutrition, the number of plants surviving after the fourth cut was greater with those growing under the stress of poor mineral nutrition.

Growth component studies with early and late varieties of grasses indicate that early varieties produce more cut herbage at utilizable height in spring, not because increases in above-ground production occur earlier, but because leaf and stem elongation begin earlier than in the later varieties.

Nutritional value of different hays

Feeding trials with yearling cattle and sheep have shown marked differences in dry matter intake of hays of S.24 ryegrass, S.51 timothy and S.37 cocksfoot. More ryegrass than timothy was eaten and the intake of cocksfoot (a stemmy hay made in poor weather) was less. Adding red clover to the cocksfoot led to a marked increase in voluntary intake and gave the highest liveweight gains. Grinding and pelleting the hays increased intake and liveweight gains.

Potential sources of breeding material have been examined in the glasshouse and the field, for the improvement of S.59 red fescue. Red fescue has a high potential value for use in reseeding hill land because of its winter hardiness, early-spring growth and its tolerance of low fertility and sheep grazing.

Herbage crops for seed

Long-term studies of the management of herbage seed crops begin to suggest means of increasing seed yields, especially those of the early-flowering varieties such as S.170 tall fescue and S.345 cocksfoot. Established drill crops of these varieties benefit from liberal dressing of complete fertilizer during early autumn, provided that the excess growth is removed by intensive grazing or cutting during December to February, followed by small dressings of nitrogenous fertilizer in the spring. Carbohydrate changes in developing seeds have been the subject of experiments indicating that starch accumulation can continue after the seed is detached from the parent culm. This opens out the feasibility of post-harvest seed conditioning. The control mechanisms of the ripening process are being further studied.

Fodder radish

Experience with this crop on the farm scale shows that it can give good yields of palatable forage a short time after sowing. It is, however, important, the Report states, to utilize it before an advanced stage of flowering is reached, otherwise much of its value is lost through over-maturity. Trials at the Station indicate that late-flowering strains could, with advantage, replace early types to give a longer period of utilization in the autumn.

Research Bulletins

The Station will in future publish periodically a number of Research Bulletins on specific topics. The titles of those at present in preparation are as follows: Experimental Work on Hill Land Improvement; Management for Production and Quality in different Species and Varieties of Grass; and Principles of Herbage Seed Production.

Burning Gorse

Burning gorse is a necessary practice on many farms. To minimize the risk to birds and other wild life, farmers who plan to burn gorse are urged to do so during winter months and complete it *before the end of March* to avoid the nesting season. Precautions should be taken. Sufficient people should be present throughout the entire operation, adequately equipped with 'beaters' such as wet sacks, shovels or spades, to control the burning. Essential precautions are:

1. Burning should be undertaken only on a calm day.
2. Burning should always be carried out into (against) the wind.
3. Burn early in the day if possible and do not burn after dusk.
4. Ensure that there is an adequate firebreak between the area to be burnt and adjacent property when this includes forestry plantations, other woodland areas or buildings.
5. Notify neighbours in advance when burning is to be undertaken (at least 48 hours notice is desirable). If there is any doubt about the adequacy of the precautions necessary to prevent the spread of fire, the Chief Fire Officer and, in the case of forestry plantations, the local Forestry Commission Officer should be consulted.
6. Make sure that all fires are out before leaving the area.

Low-cost Glasshouses

J. G. Large

MOST suppliers of glasshouses now offer a cheaper, small-span house, in addition to their more expensive wide-span vinery house. There are several good reasons for this recent change. Perhaps the most important is that, of just over 9,000 glasshouse holdings, more than 8,000 are under one acre in size. For these smaller nurseries the most important factor in exploiting modern technical improvements in mechanization and heating is to develop into bigger units. Capital is almost invariably the main difficulty in expansion, so cheaper forms of glass coverage are favoured. Costs vary widely, but these small-span glasshouses are often erected at between half and two-thirds the cost of wide-span houses. Furthermore, maintenance figures are very low, due to their simplicity of construction.

Throughout the country, and particularly in the East Riding of Yorkshire, a low-cost type of glasshouse is to be found. Usually these are Dutch light structures or the 'Venlo' house which has developed from them, but there are also several acres of glass built from secondhand materials. Much of this glass has developed in conjunction with the spring lettuce crop, from which only a modest return can be expected. The succeeding summer crop of tomatoes or cucumbers then becomes a late crop, and again only moderate returns are possible. The low capital input is thus consistent with the low to moderate output.

Dutch light structures

The real home of the low-cost glasshouse is undoubtedly Holland. Dutch immigrants in the early 1930s brought the first simple frames into the East Riding and later the timber Dutch light structures based on these frames were built. The framework consisted of 4 in. × 2 in. timber uprights spaced to give bays 10 ft wide and 9 ft long, with timber gutters. The early centres of production were at Brough, Cottingham and Woodmansey, all within 12 miles of Hull. Since these early days, the advantages of cheap glasshouses for the production of unheated crops of lettuce and tomatoes has spread, most notably to the Land Settlement Association estates. The tenants of

these estates soon found that these simple houses grew good crops and were easy to move to fresh land. Furthermore, if they moved off the estates to holdings of their own, they could easily take these structures with them.

Soil sterilization

Until recent years sterilization was mainly by formaldehyde, and the usual experience of these unheated tomato growers was one of steadily decreasing yields, even with careful use of this chemical. Fungus root troubles could build up, but more important in the 1930s and 1940s was infestation by potato root eelworm. Steam sterilization was often considered too expensive, sometimes a mobile boiler was not available for hire, or it might be thought undesirable because the strong growth resulting could not be channelled into fruit production. Thus the practice of moving the whole glasshouse structure became accepted practice, and is still so today, although to a considerably lesser extent than in the past. Sometimes the framework was left in position and the Dutch light frames were taken off during the winter, used for a lettuce crop on the flat, and then put back on to the same or another structure for the summer tomato crop. A framework might be left uncropped for three seasons, in the hope that this rest would eventually enable a good tomato crop to be taken. If excess soluble salts had been building up, succeeding lettuce crops would benefit also.

Nowadays, there is less need to move structures because improved chemicals are available, such as Dazomet and Metham-sodium, which give a good control of both potato root eelworm and root rot diseases. Also, labour for moving has become more difficult. Nevertheless, the benefits of new soil for tomatoes are considerable, and the delay of eight to ten weeks needed after using chemicals for sterilizing can be reduced. It will, therefore, continue to be common practice for growers with wooden structures for many years to come.

Recent development

Development of the simplest Dutch light glasshouse has gone through several stages. Usually every change has involved increased expenditure, but the basic idea of using a large sheet of glass as the building unit has remained. The simple Dutch light frames became available as rebated lights and this gave a less leaky house which it was worth while to heat. The framed light then became an unframed one by the use of a wooden sash-bar grooved on both sides. In Holland, steel sash-bars were used. In England this was not taken up, but aluminium alloy is now being used by most firms. As the glasshouse became snugger the humidity increased and improved ventilation became necessary. Propping a few lights up with pieces of wood along the gutters gave way to hand levers, then wires and pulleys with hand-winches, and eventually to rack-and-pinion systems in the latest aluminium alloy 'Venlo' houses.

The glass in the old houses was 24 oz in weight, $28\frac{3}{4}$ in. wide and $54\frac{1}{2}$ in. long. When steel gutters and steel framework were used the houses were widened to 10 ft 6 in. and the roof slope gradually increased from the shallowest pitch of 11 degrees to 26 degrees. Stronger glass became necessary and 32 oz is used in the most modern houses, still $28\frac{3}{4}$ in. wide, but up to 70 in. long.

Heating

As the Dutch light glasshouse improved in light transmission and reduced in leaks, so the attraction of installing some form of heating system increased. This development was also stimulated by the one-third grant offered under the Horticulture Improvement Scheme. In 1960 this was restricted to improving existing heating systems, but in 1964 new heating systems were grant-aided where the glasshouses had been cropped for the previous two years.

Low-cost houses needed low-cost heating systems, and so it was not surprising to find cheap, paraffin-burning stoves being installed. The most popular burnt one gallon of paraffin per hour giving 140,000 B.t.u. and, provided high grade paraffin was burnt and the number of stoves kept down to about six per acre, very good results were obtained. The lettuce crop in particular benefited when these were used judiciously—to keep out frost in January and February and to produce CO_2 and increased day temperatures during sunny weather.

Where a heat lift of about 15 degrees F was needed, hot air heaters burning the light, 35-second oil became popular on the smaller nurseries. These heaters could be moved easily and so were an attractive proposition to the Dutch light glasshouse grower who only needed a little heat to advance part of his crop by 3–4 weeks. The larger growers could see the economies resulting from burning the heavier oils, usually 960-second oil, and began to install steam boilers. Low-pressure steam heating with a single $1\frac{1}{4}$ in. pipe below the gutters was the simplest and cheapest choice of pipe heating system. This provided a steam main wherever heating was given and meant that steam sterilization could be used. As the 10 ft 6 in. wide metal house evolved and became a precision-built structure well sealed and equipped, the type of cropping also changed. Tomatoes and cucumbers could be planted earlier if a heat lift of 30 degrees F was available, and this increased flexibility in cropping proved attractive to the leading growers. More expensive high-speed hot-water systems were installed by some. The heating pipes were supported on the gutter posts, so that the floor of the glasshouse was unobstructed.

Irrigation systems

At an early stage a move away from hose-pipe watering was made. Overhead spraylines were inserted below the ridge and in one type of metal house in the ridge piping itself. Usually there was only a single nozzle per bay, and a large volume of water at considerable pressure was needed to give a good misting action. In the East Riding the spring lettuce crop has always been regarded as more important than the summer crop of tomatoes, in unheated houses, and the ease with which watering could be done overhead no doubt helped to bring the sprayline into widespread use. Following Dutch practice, the tomato crop was then watered overhead as well, with the liquid feed also added in heated houses. In unheated houses it was found better to lower the sprayline to a foot or so from the ground when the plant tops reached the wires. The spraylines were usually 1 in. diameter galvanized steel, with screw-in nozzles. The earliest nozzles were simple four-slot, made of saw-cuts, but nowadays several types are available. Plastic lines made of unplasticized polyvinyl chloride (UPVC) are the cheapest, but galvanized steel is still widely used. Most recently the principal firms have offered aluminium alloy spraylines at only slightly greater cost.

Conclusion

From all that has been said in their favour, small-span glasshouses have their disadvantages, principally because they are poorer in light transmission. Where high-value crops are being grown, such as A.Y.R. chrysanthemums, carnations, early tomatoes and cucumbers, the choice for established growers should be for the best possible house. A steady increase in the area of aluminium alloy 30 ft and 60 ft open glasshouses along the south coast is to be expected. But for smaller nurseries, where a newcomer is entering the industry, and especially where low and medium value crops are being grown, then the cheaper small-span glasshouse is the obvious choice.

The author of this article, **J. G. Large, B.Sc. (Hort.)**, is the N.A.A.S. County Horticultural Adviser in the East Riding of Yorkshire. Before taking up this post, he worked in the Worthing district of West Sussex and had previously spent five years in the Glasshouse Department of the Ministry's Efford Experimental Horticulture Station.

The Ministry's Publications

Since the list published in the December, 1966, issue of *Agriculture* (p. 587), the following publications have been issued.

MAJOR PUBLICATIONS

Bulletin No. 147. Electric Fencing (New) 5*s*. (by post 5*s*. 5*d*.)

ADVISORY LEAFLETS

(*Price 4d. each—by post 7d.*)

No. 76. External Parasites of Poultry (Revised)

No. 222. Cream Cheese (Revised)

No. 274. Wart Disease of Potatoes (Revised)

No. 340. Cucumber Mosaic (Revised)

No. 400. Cob-nuts and Filberts (Revised)

No. 440. Stem Eelworm on Vegetables (Revised)

No. 456. Bulb Scale Mite (Revised)

The publications listed above are obtainable from Government Bookshops (addresses on p. 54), or through any bookseller.

48. South Westmorland

J. R. Thompson

THE southern district of Westmorland is very compact and is barely 12 miles from Kendal to the boundary. Total acreage is 102,000, with 72,000 acres crops and grass and 30,000 acres rough grazing. Some of this rough grazing is enclosed and the remainder is common land. There are only about 2,000 acres of cereals and over half of this acreage is concentrated on ten of the larger farms.

Of the 993 holdings in the district, 269 are under 20 acres and can be disregarded as serious economic agricultural holdings. Of the remaining 724, there are 273 with more than 100 acres crops and grass and 451 with less than 100 acres.

With the preponderance of small farms the emphasis must inevitably be upon milk; and some of the most efficient milk producers and cattle-breeders in the country are in the district. The standard of management is extremely high, as might be expected on a family farm.

Since cow cubicles were introduced there has been a very rapid spread in loose housing and parlour milking. There are over 10½ million gallons of milk produced annually and this figure is rising rapidly. Despite this high milk output practically every farm is self-supporting for dairy replacements, and the sale of newly-calved cows to neighbouring counties is an important part of farm income.

Sheep also play an important part throughout the district with a breeding flock of ewes on almost every farm. At present there are about 70,000 breeding ewes, ranging from pure-bred hill ewes receiving the full rate of hill sheep subsidy, to draft hill ewes on the marginal land crossed with long-wooled rams to produce masham and mule lambs, and finally masham ewes crossed with Down rams for fat lamb production.

Intensive grazing systems are practised and set-stocking at 6–7 ewes per acre from April to August appears to be the most popular. This practice is spreading rapidly.

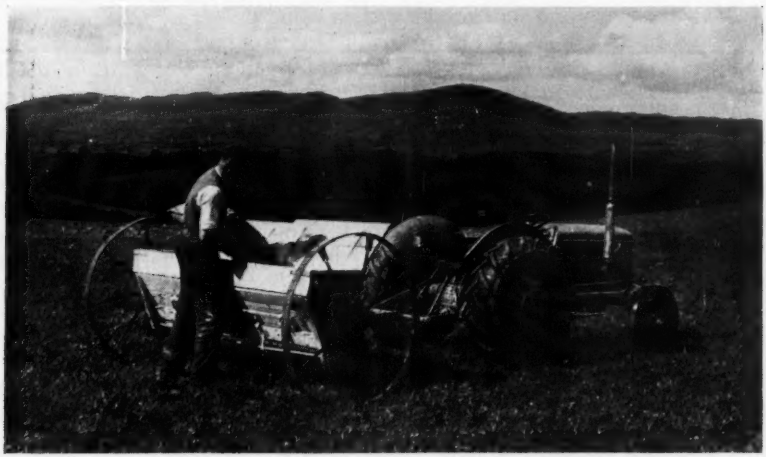
The hill land in the district is much kinder than that in central Lakeland or on the East Fellsides and a lambing percentage of 100 is normally expected and attained.

The district divides into three contrasting and interesting valleys, all of which run into Morecambe Bay. The Lyth Valley in the west, which is famous for its damsons, is very flat and lies only about 20 ft above sea level. The lower end of the valley was at one time an inland lake and there is still raw peat cut for burning alongside relatively productive grassland.

The valley is surrounded by steep limestone outcrops. There is, therefore, a high water-table and, because of the peaty nature of the soil, drainage is slow and difficult. Intensive livestock systems and arable cropping are ruled out.

The Kent Valley in the centre is much different in character. This is a typical glacial valley with the well-known drumlins. The land is of a rolling nature and in the main very free-draining and eminently suitable for intensive grassland and livestock production. Stocking rates are generally high on the majority of farms, running at 1·2 acres per livestock unit.

Farming in the Lune Valley in the east is again different. This is a true river valley with a narrow belt of fertile, free-draining land at the bottom, but it rapidly rises to wet marginal land with hill-grazings above this. The system of farming depends upon the proportion of inside land to hill, but hill sheep tend to dominate farming systems, competing with the dairy cows and in many cases reducing profits.



The upper Kent Valley, showing the typical glacial formation

New techniques are rapidly taken up throughout the whole district but shortage of skilled labour is now preventing many farmers reaching their full potential. This shortage of labour is likely to become worse with more industrial development and the construction of a new motorway.

Kendal is the fascinating market town for the area, very wealthy, and with a tremendous diversity of industry. It is this diversity of industry, its high demand for labour and high wages, with which the farmers have to compete. A well-known shoe factory alone employs 2,000 workers. Other industries in the district include manufacturers of water turbines, stockings, light engineering, brushes, organs, snuff, paper-makers, sweets, and many others.

Under continual economic pressure farms are becoming larger and more intensive, with grass as the hub of all the systems.

Housing the Growing Dairy Herd

N. M. Spink
Agricultural Land Service

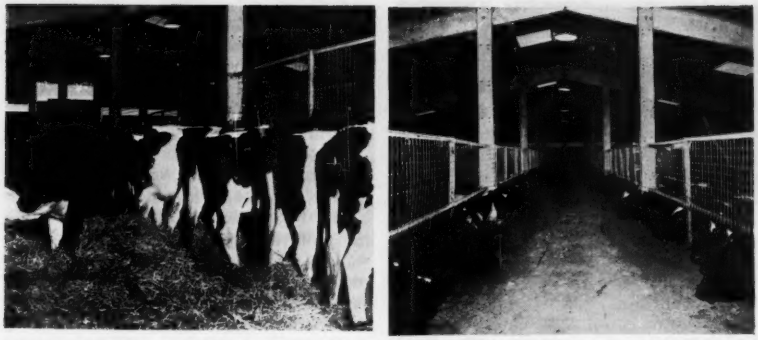
THOSE not resident in Surrey usually regard the county as being largely taken over for housing development and so are surprised to learn of its considerable agricultural interests, particularly in dairying.

As in other areas, the problem is not just the accommodation of an increasing herd with possible high capital expenditure. The necessity for economy in the use of farm labour, to meet the competing needs resulting from high wages paid for all kinds of work, including farming, near to London, must also be taken into account.

There is no single answer to this problem and this is illustrated by the way it has been dealt with on three farms within a 12-mile radius in the county.

Canon Farm, Burgh Heath, farmed by Mr. David Roe, comprises 500 acres, including 180 acres under corn. His 100-head Friesian herd used to be milked in ten cowsheds in two sets of farm buildings by four men, with reliefs. Today, the cows are milked by two men in an abreast-type parlour converted from one of the cowsheds and accommodated in a new covered yard which immediately adjoins. One of the main features of this system is the almost complete elimination of slurry achieved by the cows feeding off the bedded area from a raised central feeding passage. This passage is wide enough to allow tractor and self-unloading trailer with hay or silage to pass along it and so facilitate feeding. The system has been made possible by reason of the tonnage of straw produced on the farm which enables the yard to be well bedded down and the cows kept clean. The total gross capital cost was £60 a cow but it has been possible to reduce the labour force to two men for a possible 100 cows in milk. The photographs show the cows feeding off the bedded area from the raised feeding passage.

Goldstone Farm, Great Bookham, is a 248-acre holding but, unlike Canon Farm, the land is very undulating and this influenced the decision to extend one of the existing cowhouses. Originally, the 60 Ayrshires were milked in three cowhouses widely separated from each other and from the dairy. A cowhouse for 36 was extended to provide 67 standings, the doorways were widened and advantage taken of the levels to form a drop at the end of the extended cowhouse so as to permit the muck being pushed out



The cows standing on the bedded area (left) are feeding off the raised feeding passage (right)

by tractor through the cowhouse on to a waiting trailer. This operation takes 10 minutes a day. Two men are still employed for milking but the time has been cut from 4½ to 2½ hours a day. A new dairy, and other improvements, were made at the same time and the total gross capital cost was £131 a cow on 31 cows, or less if the benefit is rightly taken as being for the whole herd. Round-the-shed milking was provided by the tenants, Messrs. J. Gray and Son, at the same time as the improvements.

Guinness Dairy Farm, Woking, tenanted by Lord Elveden, extends to over 800 acres of effective agricultural land and is subdivided into three dairy units, all of which are being modernized. At Hoebridge, the Guernsey herd was accommodated in a small yard covered by corrugated iron and milked through an early type of parlour with separate washing stalls. In the completely redesigned unit the cows are always under cover, whether in the cubicles, self-feed silage or collection areas, and they are milked in a new 16-stall, 8-unit herringbone parlour; 103 cubicles were provided, but last winter the building was occupied by 115 cows without difficulty. Slurry was scraped outside the building area over a grid into a pit, where it was augered into a tank with a three weeks' holding capacity. Although the gross cost per cow, at £145, is higher than in the other two cases, two mens' labour has been saved.

The solutions bound to the three very similar problems emphasizes once again that all farms are different and that there is no set answer to the type of accommodation required for dairy cows. However, before large sums of money—both landlords' and tenants'—are committed, it is esssntial that each individual case should be critically examined in order to find the correct solution. All concerned with these three farms in Surrey believe that the systems evolved are the right ones in their particular circumstances.

Books

Endosymbiosis of Animals with Plant Microorganisms. PAUL BUCHNER. Revised English version by BERTHA MUELLER and FRANCIS H. FOECKLER. John Wiley and Sons, 1966. £13 3*s*.

It has long been known that many microorganisms, algal, fungal, bacterial, and protozoan, can live symbiotically in the bodies of higher organisms, assisting in their digestive processes and general metabolism. Professor Buchner's book on this fascinating aspect of biology traces the history of our knowledge of it from the earliest misinterpreted observations, through the period of controversy when the first true explanations were found incredible, to the time when these ideas became generally accepted. It then goes on to deal exhaustively with every aspect of a subject which the author has made his own since 1911.

Agriculturists may be disappointed that his terms of reference are not wider, so as to include more aspects of practical importance to themselves. Not only does the book not attempt to deal with the symbionts of the plant world, thus ruling out topics of such wide significance as mycorhiza or the bacterial nodules on the roots of the Leguminosae, but in the animal kingdom it is confined to the symbionts of invertebrates. This means that the role of microorganisms in ruminal physiology, cellulose digestion, and the synthesis of essential vitamins in the domestic animals are entirely omitted, save for a passing reference in the last half-dozen pages. However, it would be ungrateful to criticize so excellent and interesting a work for failing to cover ground which, from the outset, was beyond its terms of reference. And as even the limited field fills 900 pages, it would clearly be impracticable to ask for more.

All groups of invertebrate animals known to contain symbionts are reviewed, and classified according to the type of food consumed. Especial attention is shown to the various ways in which essential symbiotic organisms are transmitted from one generation of host to the next, and the embryonic development is carefully traced. Much detail is also given about luminous organisms living in marine molluscs and other forms, in specific organs that were previously believed to be light-producing themselves. The antiquity of such symbiosis is shown by the way in which transparent lens-like structures have evolved in the tissues overlying these luminous organs, through which the beams of light are directed.

The book is profusely illustrated, and has a useful bibliography extending to 50 pages. It also has an alphabetical list of authors quoted, and another of the scientific names of animals and plants mentioned in the text. It is, however, regrettable that there is no alphabetical index to the subject matter, though this lack is partially offset by a detailed list of contents running to ten pages and amounting to a summary of the whole work, with page reference to each topic mentioned.

R.M.G.

Recent Advances in Animal Nutrition. Edited by J. T. ABRAMS. J. and A. Churchill, 1966. 36*s*.

With the ever-growing volume of scientific literature produced each year, no one can possibly read more than a small proportion of it. The difficulty becomes even greater in such a diversified field as science applied to agriculture, owing to the complex interrelationships of science disciplines with husbandry. The animal nutrition specialist, whether student or lecturer, adviser or research worker, has to rely heavily on the various abstracting journals and periodic reviews for new knowledge, but in their attempts to be comprehensive these publications cannot be discriminating in their choice of material nor are they able to guide the reader to what is really important. With these points in mind, Dr. Abrams accepted overall responsibility for a series of dissertations under the general title of *Recent Advances in Animal Nutrition*. In his preface he states that 'the volume was planned in the belief that critical reviews should be useful to students as well as to lecturers and those engaged in research'.

In essence, this modest-sized and relatively low-priced book comprises a series

of seven essays written by well-known people eminent in different fields. The subjects covered are processing effects on nutritive values of foods, balance trials, herbage, poultry nutrition, the importance to ruminants of vitamin A, protein and energy metabolism of pigs, and nutritional aspects of the growth of the laboratory rat. Each essay is well documented by a bibliography and the whole book is comprehensively indexed. The choice of some of the subjects may appear surprising; even more so is the omission of consideration of the ruminants (apart from the one essay devoted to the influence of a single nutrient on these species), but the editor may not have been able to secure the necessary collaboration.

Taken as a whole, the book is an invaluable and well-produced mine of information. How far it fulfils its objective of providing critical reviews of each of the topics covered is a matter for the opinion of the reader. One or two of the essays appear to highlight the findings of the particular researches of their authors and associates rather than to survey objectively the field indicated by the title, whereas others attempt a broad review of more recent work. It is evident that a work of this nature must 'date' fairly rapidly and 'recent advances' must soon become history. The editor should feel sufficiently encouraged by the success that he and his collaborators have achieved in the present volume to continue the pursuit of his declared objective of easing the burden of those who are fighting a losing battle in their attempts to keep abreast of the literature of animal nutrition. It is hoped that this will be the first of many such volumes. The field is sufficiently vast to avoid the danger of a too-frequent return to the themes already covered.

A.E.

Farming Technique from Prehistoric to Modern Times. G. E. FUSSELL. Pergamon Press, 1966. 30*s*.

The title misleads. The phrase 'in Europe' should be added to it, since little reference is made to other continents. But this is a purely formal criticism of a very important book. For in 270 packed and well-illustrated pages Mr. Fussell has provided the general reader and the student with the first systematic and popular history of farming from its origins to the present day which has appeared in this country.

He begins at the very beginning, with the forgotten Neolithic breadgivers, whom men later honoured as Demeter and Ceres, and traces the development of the prehistoric slash-and-burn system and the crude 'ploughing' of the *ard* to the sophisticated Graeco-Roman agriculture we know from classical writings as well as from archaeology. He then describes the Dark and Middle Ages and the slow spread of that stupendous reclamation which created the modern European landscape, and finally brings us to the improvers of the Age of Enlightenment and the rise of industrial farming based firmly on the products of the factory and the findings of the laboratory. And as he goes along, he comments in agreeable detail on crops and stock, tools and systems, on changes and inventions, on the survival of primitive methods and the early, prophetic appearance of techniques whose revolutionary importance lay in the future.

The value of this book, however, does not lie solely in the author's text. It also lies in the mass of references to books and articles at the end of each chapter and in the final bibliography of 300 titles. Indeed, the text can be compared to an aerial survey which shows the general lie of the land, the directions in which the rivers flow, the positions of the main ranges, roads and cities. But when we wish to explore a certain area, a certain subject, we must turn for guidance to the detailed publications which Mr. Fussell lists with such painstaking scholarship.

Author and publisher are to be congratulated on this valuable and well-produced introduction to a vast but fascinating subject.

N.H

Sixty Years a Fenman. ARTHUR RANDELL. (Edited by Enid Porter). Routledge and Kegan Paul, 1966. 25*s*.

Few places in rural England have not been touched by the wind of change that has been blowing steadily since the thirties. We may not stand up and cheer every innovation labelled 'progress', we may regret the passing of old skills, customs and homespun pleasures that have existed at the core of village life for centuries, but these, we accept, must inevitably be casualties of a more prosperous, more dynamic rural Britain.

It is important, nevertheless, that knowledge of the old ways of country life should not also be lost; and it is for this reason that Arthur Randell's recorded memories, spanning the greater part of a hundred years of

life in the Fens, will be welcomed by the social historian.

Long developing in semi-isolation, this area of England has inevitably a history of introspective culture, with all that this means in the character and language of its people, its folklore and its superstitions.

Born in Wiggenhall St. Mary Magdalen in the Norfolk Fens, some seven miles from King's Lynn, Arthur Randell succeeded to the common heritage of the Fenmen of his time—hard work and little leisure. The bastion of their security against the sea lay, as it must always do, in the efficiency of their dykes and drains: but pick, shovel and paddle wheels were the tools in the author's boyhood; the massive machines and the powerful modern pumps had yet to come.

But if daily routines were arduous, there was always time to observe and enjoy the local traditions that marked each season—'mumping' for the old people as Christmas approached, the handbell ringing on Boxing Day, the gusto of Plough Monday, the revels of the Horkey Supper to the music of accordion and fiddle.

Superstitions die hard, if they die at all, and belief in spell-binding by local witches was not to be lightly dismissed in the eerie darkness of deserted fields and lonely roads. 'Like most village children', says the author, 'we were never allowed to go out after dark on Witches' Night (2nd February) when evil was supposed to be abroad in the Fens.'

Old-fashioned medication—part herbal, part faith—against every ailment was ready to hand in the kitchen. So-called 'ferret's milk' (a pint of milk in which a ferret was allowed to paddle about) was a sure remedy for whooping cough, whilst the humble mole brought relief to sufferers from rheumatism and formerly the ague which was so prevalent in the Fens.

This is a book that entertains as well as it enriches, and the publishers are to be commended for adding it to their other estimable books on Fen life and times.

S.R.O'H.

The Changing Location of Intensive Crops: An Analysis of their Spatial Distribution in Kent and the Implications for Land-use Planning. R. H. BEST and RUTH GASSON. Wye College, 10*s.* 6*d.* (including postage).

This survey, one of a series which deals with the location of intensive crops up to 1962, is perhaps the most stimulating recent contribution dealing with rural land use at a time when the pattern of horticultural production in the United Kingdom is changing so fast that the report already needs revision. The format is pleasant, the figures profuse and clear and the references extensive.

With the best fruit farms changing hands at £600–700 per acre, the subject is of great current interest to growers and others concerned with land use. The authors state that it should be possible to find suitable sites for development in Kent without seriously affecting the continual growth of a more efficient and productive industry.

A minor criticism is a reliance upon relative comparisons, e.g., Figure 30 shows the proportion of orchard trees planted after 1950 in England and Wales as a percentage of the 1957 acreage—Pembrokeshire is shown in the vanguard with S.E. England! There is also an implication of a trend towards more intensive production on Romney Marsh. It is paradoxical that on the Marsh, water for irrigation has a scarcity value and exposure is also a limiting factor in the production of many horticultural crops. A move towards the contract growing of vegetables for processing three or four years ago was short-lived and no major changes have taken place since.

The report, enhanced by a short foreword by Professor G. P. Wibberley, whose own work has done much to put rural land use on a sound quantitative basis, is excellent value for 10*s.* 6*d.*

Copies may be obtained from the Secretary, Department of Economics, Wye College, Ashford, Kent.

E.C.H.

Muscles of the Ox. R. M. BUTTERFIELD and N. D. S. MAY. University of Queensland Press, 1966. $8.50.

In recent years there has been a marked increase in the interest of research workers in the body composition of meat animals, but so far there are very few simple texts which these workers can consult for positive identification of the structures with which they are working. In this book the authors set out to compile a description of the individual muscles of the commercial beef carcass so that uniform identification and description will be possible in future research.

The basis of the text is the individual muscle dissection of one-hundred-and-ten half-carcasses which were dissected by the senior author in a study of the relative

growth of the musculature of bovine animals. Only those muscles which are found in dressed commercial ox carcass sides are described; the title of the book is, therefore, a little misleading as there is no reference to some important muscles, such as those of the tongue, diaphragm, head and tail.

The various muscles are described in the order in which they are dissected and this order is arranged so as to provide the maximum exposure of each attachment. Each description is introduced by brief instructions to assist in locating the muscle and with a statement of (*a*) a percentage value of the weight of the muscle relative to the total side muscle weight and (*b*) the approximate weight in a chilled 227 kg (500 lb) carcass yielding 136 kg (300 lb) of muscle.

Origins and insertions are set out in sufficient detail to ensure a uniform routine of dissection, while the descriptions of the structure of each muscle is commensurate with its size and complexity. Relations with bones and other muscles are listed in the order that is most appropriate for the dissection technique. Brief notes are included to assist in the initial stages of a dissection sequence. The line drawings of dissection fields and photographs of individual muscles are clear and well labelled. The use of bright colours to illustrate areas of muscle attachment to boney origins and insertions is also successful.

Since the book went to press anatomical nomenclature has been revised by the World Association of Veterinary Anatomists but it has been possible to publish a list of synonyms which, one would hope, should help to standardize the nomenclature for workers in this field for all time to come.

This is a work which has been written by specialists for specialists whose numbers and whose needs are continually creating a demand for this type of information.

J.G.S.B.

Introduction to Crop Husbandry. J. A. R. LOCKHART and A. J. L. WISEMAN. Pergamon Press, 1966. 21*s*.

Candidates for the City and Guilds Examinations in Agriculture should have no difficulty in obtaining written guidance in crop husbandry; this is the second book on the subject published this year to cater for their needs. In contrast with the earlier work (*Principles of Crop Husbandry I.* F.A.W. Peregrine, R. P. Weston and G. J. England. Hutchinson, 1966) which was aimed specifically at the farm institute student, this is, by implication, also a basic text for students in the agricultural colleges.

In the words of the preface, the book covers 'all aspects of the subject . . . the growth and development of plants, types and management of soils, drainage and irrigation, modern practices of growing and harvesting crops, management of grassland —including conservation, typical life cycles of common pests and diseases, and the latest developments in the use of chemicals as fertilizers and in the control of weeds, pests and diseases'. This is a formidable brief and has necessitated fairly drastic condensation to keep the book within reasonable bounds of size and price. Where the authors are dealing with clear-cut factual information, this has been very successfully done by the intelligent use of tables and diagrams. This layout, combined with a comprehensive index, makes reference to factual matter quick and easy. Illustration is by numerous, clear and apt line-drawings. The lavish use of italics may be deemed a blemish by some.

The condensed form has its dangers, however, in that necessary qualification of statements tends to be omitted, giving an unintended air of dogma to the work. There are some inaccuracies, most noticeably in the chapter on soils where, for example, the impression is given that the shrinkage of clay soils is caused by the pressure of the air attempting to enter the soil as it dries. Certain long-held but ill-founded beliefs are perpetuated; for example, that clays are the most drought-resistant soils when Salter's work has demonstrated quite clearly that this is not so. These difficulties could have been largely overcome had the reader been directed by references to work giving a more specialized treatment of the various sections. This would have given the term 'Introduction' in the title full validity.

These criticisms apart, this is likely to prove a useful and popular book for the student. It is compact, packed with easily accessible information and as comprehensive as it could be in the space available.

R.S.E.

Agrarian England in the Later Middle Ages. G. A. J. HODGETT. The Historical Association: Aids for Teachers Series No. 13, 1966. 2*s*.

Mr. Hodgett surveys the period from about 1250 to about 1500. He discusses such matters as land tenure, the size of holdings, prices and rents, and farming methods. There is a bibliography for those who wish to carry their studies further.

H.G.B.

Mink on my Shoulder. RICHARD SERJEANT. Robert Hale, 1966. 18*s*.

There is something quite remarkable about the mink, and its fellow mustelids such as the marten, wolverine, otter, stoat and weasel. In their several ways they are all vividly and tenaciously alive; all are mercurial, playful and—either casually or ruthlessly—predatory. But mink have been the darlings of the fur breeders, in Canada, the U.S.A. and Scandinavia, for several decades and account for two-thirds of the world fur trade.

The author first heard about mink farming when serving with the Air Force in Burma in 1944. A year later he became one of the first post-war mink farmers in Britain and for over twelve years he enjoyed the trials and vicissitudes of mink breeding, the hopes of producing a new mutation and the pleasure of a great variety of acquaintances, before becoming the editor of the *British Fur Farmers Gazette*. It is clear from his book that Mr. Serjeant is a hard worker and an optimist, and when assailed by misfortune, by sickness among his animals or by personal accident, he yet finds consolation and hope for the future.

There is much to be learnt about mink farming and, when one is starting from scratch, with few to look to for advice, it is easy for a mink occasionally to escape. As the author writes 'Escapes . . . were a perennial hazard in the early days'; they are still, and the need is evident for the Mink Orders and Regulations, which were made in 1962, relating to the importation and keeping of mink.

In his early days, despite the innumerable problems, such as the hazards of handling and mating mink and the losses in weight of those which were over-exercised, Mr. Serjeant achieved welcome recognition and publicity by persuading *Pathe Gazette* to include a short film about his mink farm in one of their cinema newsreels. This was followed by a radio talk and articles in periodicals, and an embarrassing number of requests for breeding stock by hundreds of people who hoped to make a fortune from backyard mink keeping. It is to be hoped that most of them were dissuaded from the venture for, with all his experience and undoubted zest, the author makes it very clear that mink farming is no sinecure and that both capital and stock may easily be lost.

Besides the personal saga of mink farming, the book also deals briefly with the intricacies of the furrier's art and the fur trade generally.

H.V.T.

The College of Agriculture. C. E. KELLOGG and D. C. KNAPP. McGraw-Hill, 1966. 56*s*.

This volume, which is the latest in the Carnegie Series on American Education, is the outcome of a three-year study by two well-known authorities in agricultural education. Briefly stated, it poses the following question—are the curricula and teaching methods of agricultural colleges flexible enough to meet the changing needs of agriculture in the U.S.A.?

In their view, agriculture nowadays includes much more than the farm production processes of crops and livestock. It also covers the servicing of farmers with machines, chemicals and other supplies required for production, as well as marketing, processing and distribution of farm products. Furthermore, it embraces alternative uses of rural land, the social welfare of people in rural areas, and services for credit, taxation, foreign trade, economic development, and training of overseas students.

Such a concept is far removed from the historical function of the colleges which were set up to educate rural children and help farmers improve yields of crops and livestock. As one might expect, the authors conclude that some seats of learning are modifying their patterns of instruction but there is still much to be done.

Unlike England and Wales but comparable to Scotland, the term 'College of Agriculture' covers not only undergraduate teaching, but also research and extension, for under the U.S. system these come under the control of one head. So the material in this book ranges much beyond the physical confines of the campus itself.

At the colleges themselves, it is suggested that the curriculum should encompass, firstly, a general education in the basic sciences, mathematics and humanities. This should be followed by a limited introduction to the broad field of agriculture in the first two years and concentration in a major field of agricultural science in the third and perhaps fourth year. The authors believe that research itself cannot be neatly subdivided into 'basic' and 'applied' sections. Most of the problems involve both and are often of an interdisciplinary sort as well.

This study concludes that some colleges have lost their sense of urgency, but others have anticipated the problems and made the required adjustments. Does the same apply in the U.K.?

H.E.

Cassell Farm Books. 5*s*. each.

No. 9. Farm Planning. M. HOSKEN.
No. 10. Farm Accounts. F. LAWN.
No. 11. Farm Records. M. HOSKEN.

These are three recent additions to an excellent series. As stated in one of the introductions 'Farming is a Business', nothing but good can come from stressing this fact early in a prospective farmer's life. Essentially student's books, between them they fill a much needed gap in the library on various aspects of farm business management. Also, as the editor stresses, each one should be read and used in conjunction with the other two volumes in the series.

All three are well-written in a style which should appeal to the student, particularly the part-time student, and also the new entrant to farming. On reading all three of them, one comes across a certain amount of duplication; this is perhaps inevitable and indeed it is often highly desirable to have important points stressed more than once.

So often in farm management literature the need for accurate data is emphasized but seldom, if ever, does one see how the information can be physically collected. Those who profess an interest in management, particularly students, are good at 'figuring', but seldom have any idea how to set about the job on the farm. *Farm Records* (No. 11 in the series) does this very well; perhaps the fastidious would question the title.

Farm Planning should certainly appeal to farmers, young and old alike, as well as to students; it sets out clearly the type of information that should be taken into account when making a change and, more important, how to use this data. It is questionable whether the section 'Other Systems of Analysis' should really appear in this booklet; surely it is much more appropriate to *Farm Accounts*. On the other hand, it might be worth while in future editions to include a summary of 'Definitions' and 'Indices' as an appendix in all three publications.

It is not generally recognized, and these booklets do not rectify this, that when one records the whole farm business on a gross margin basis more, rather than less, information is required. This is one of the reasons why so many advisers, when looking at the farm business for the first time, tend to use the 'comparative analysis' approach. After reading *Farm Accounts* and *Farm Planning*, one has the impression that the N.A.A.S. tend only to use the comparative analysis method; this is far from correct.

In present-day farming, particularly on arable farms, the so-called fixed element of costs are extremely important and too often when replanning the business, insufficient attention is paid to them. This aspect could be dealt with in a little more detail in future editions. The same might be said about capital, but perhaps the student need not worry so much about this except as it affects his own personal circumstances.

Although there are a few minor blemishes in these booklets, they should certainly meet a need, particularly for the younger reader and I shall be very surprised if they are not widely used.

A.J.D.

Eley Game Advisory Station Annual Report, 1965–66.

Much of this well-produced Report reads rather like a second instalment of the one published the year before, and this continuity of subject makes it all the more like a magazine which, year-by-year, gives a faithful account of continuing trials, work and experiments.

There is a particularly interesting article on partridge breeding, and the Station's view of the importance of this game bird is expressed in the beginning of the Report 'if you look after the partridges, the pheasants will look after themselves'.

There are many other good things too, particularly the section on rearing trials of reeves pheasants and prairie chickens. The difficulties of rearing the latter make fascinating reading; the young prairie chickens must have living food for the first three to four weeks of their lives and will drink only dewdrops. No wonder, as the Report says, they are considerably more difficult to rear than most game birds.

As in earlier reports, very many aspects of game preservation are covered, and any countryman interested in the subject will welcome this addition to his bookshelf.

Copies may be obtained, free, from the Eley Game Advisory Station, Fordingbridge, Hampshire.

R.G.A.L.

Books Received

Documentation in Agriculture and Food, No. 80. Trained manpower for tomorrow's agriculture. Organisation for Economic Co-operation and Development, 1966. 27*s*. 6*d*.

United Kingdom Dairy Facts and Figures 1966. The Federation of U.K. Milk Marketing Boards. Copies obtainable from the Milk Marketing Board, Thames Ditton, Surrey, price 7*s*. 6*d*.

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Salaries within the ranges quoted are assessed on qualifications and experience; and the terms of most appointments include free or subsidised accommodation, education grants, family passages, good leave on full pay, etc.

Most appointments are limited to nationals of the United Kingdom or the Republic of Ireland who are normally resident in those countries.

COLOMBIA

Adviser on Sugar-Cane Research

RC 213/43/06

Duties: To advise on sugar-cane research, with special regard to obtaining improved varieties or hybrids, and efficient methods of cultivation, which will be evaluated by means of regional tests.

Qualifications and terms: A degree in agriculture or botany with experience in cane research (improvement, genetics and statistics). Salary £2,400 to £2,800 a year, subject to British income tax, plus a variable, non-taxable overseas allowance payable at present at the rates of £355 (single), £630 (married unaccompanied) or £770 (married accompanied) a year. Three years contract.

GAMBIA

Agricultural Officer

RC 213/68/02

Duties: To carry out general extension work, including particularly oil palm nursery and plantation practices and supervise mixed farming centres and to administer and supervise main Agricultural Station, with limited touring.

Qualifications and terms: A degree in agriculture and experience in general extension and mixed farming. Salary £1,140—£2,224 a year plus 25% terminal gratuity. 18–24 months contract.

Crop Protection Officer

RC 213/68/010

Duties: To organise and supervise the overall crop protection unit, including the control of stored products insect pests, and general supervision and liaison with the Produce Chemist, the introduction of field and orchard crops protection techniques and the improvement of protection in village seed stores.

Qualifications and terms: A degree in Natural Science or Agriculture with post graduate experience in the control of insect pests in stored products. Salary £1,140—£2,224 a year plus 25% terminal gratuity. Contract 12 to 24 months.

Citriculturist/Horticulturist

RC 213/68/09

Duties: To plan and execute the commercial production, processing and marketing of limes on a pilot project basis and to develop subsistence vegetable growing.

Qualifications and terms: A degree or diploma in horticulture or agriculture with considerable practical experience of the duties outlined above, preferably in the tropics, and an ability to conduct rootstock, fertilizer and cultural trials. Experience in the maintenance of records would be an advantage. Salary £1,140 to £2,224 a year plus 25% gratuity. On contract for two tours of 15–18 months.

OFFICIAL APPOINTMENTS

ZAMBIA

Farm Management Specialists

Duties: To advise on, draw up, and implement production plans on projects for individual, co-operative and state Farm enterprises.

Qualifications and terms: A degree in Agriculture, or a diploma in Agriculture with experience in farm planning. Salary £1,180—£2,600 for degree holders and £1,025—£1,855 for diploma holders plus a 25% gratuity. A supplement ranging from £200—£300 a year is also payable direct to an officer's bank account in the United Kingdom or Republic of Ireland. Three years contract.

Chief Animal Husbandry Officer *RC 213/132/032*

Duties: To advise the Deputy Director of Agriculture (Extension) on all matters related to animal production, to provide specialist advice and training to staff and other Departments and to administer certain regulatory aspects related to livestock production.

Qualifications and terms: A degree in agriculture or animal husbandry and at least ten years' experience in this specialised field. Salary £2,770 a year plus 25% terminal gratuity. A supplement of £300 a year is also payable direct to the officer's bank account in the United Kingdom or the Republic of Ireland. Three years contract.

Entomologist *RC 213/132/03*

Duties: To carry out research on the identification and control of pests of agricultural and horticultural importance.

Qualifications and terms: Candidates must hold a degree in botany, zoology or entomology, preferably with post-graduate experience in applied entomology. Salary £1,330 to £2,600 a year plus 25% terminal gratuity. A supplement ranging from £200 to £300 a year is also payable to an officer's bank account in the United Kingdom or the Irish Republic. Three years contract.

Planning Officers *RC 213/132/020*

Duties: To take charge of field planning teams and to be responsible for regional conservation planning on a catchment and/or settlement plan basis.

Qualifications and terms: A degree in agriculture or natural science, preferably with post-graduate training and/or experience in the use of aerial photography, practical surveying and land use planning. Salary £1,180 to £2,600 a year plus 25% gratuity. A supplement ranging from £200 to £300 a year is also payable direct to an officer's bank account in the United Kingdom or the Irish Republic. Three years contract.

KENYA

Agricultural Officers *RC 213/95/07*

Duties: For general extension and investigational work in either European or African areas.

Qualifications and terms: A degree in Agriculture. A diploma in tropical agriculture is desirable. Salary £1,374—£2,757 a year, plus 25% terminal gratuity. Two year contract.

MALAYSIA

Agricultural Economist *RC 213/105/02*

Duties: To advise on the cultural, economic and social aspects of setting up smallholder communities under the Federal Land Development Authority.

Qualifications and terms: A degree in agricultural economics with experience of land development planning. Salary £2,500 to £3,000 a year subject to British income tax plus a variable, non-taxable overseas allowance, ranging from £445 to £1,395 a year according to marital status. Two year contract.

cont'd overleaf

OFFICIAL APPOINTMENTS

SARAWAK

Agricultural Officer

RC 213/155/04

Duties: The administration of an Agricultural Division, comprehensive advisory and supervisory duties and supervision of experiment stations and staff training.

Qualifications and terms: A degree in Agriculture or Natural Science plus at least two years' experience of tropical Agriculture. Salary £1,680—£2,905 a year plus terminal gratuity. Three year contract.

TANZANIA

Agricultural Officer (Dairy Technology)

RC 213/173/028

Duties: To advise on management of dairy farms, co-operative dairy plants and processing and marketing of dairy products.

Qualifications and terms: A degree in Agriculture with dairy production as a major subject and experience in the operation of dairy plants. Salary £1,329—£2,757 plus 25% gratuity. On contract for 21–27 months.

Agricultural Economist

RC 213/173/030

Duties: To lead the Planning and Investigation Unit of the Ministry of Land Settlement and Water Development in the examination and valuation of settlement and irrigation schemes and to train officers engaged on these schemes.

Qualifications and terms: A degree in economics with agricultural qualifications or an honours degree in agricultural economics plus some previous experience. Salary £2,814 to £3,000 plus 25% gratuity. 21–27 months contract.

Entomologist

RC 213/173/023

Duties: To be in charge of the entomological section of a regional research centre, to study the distribution of, and damage done by, field insect pests and to advise on their control.

Qualifications and terms: Candidates must have a university degree in natural science with entomology as a major subject. Post graduate training leading to a higher qualification is desirable. Salary £1,329—£2,757 a year plus 25% gratuity. 21–27 months contract.

Agricultural Officers (Animal Husbandry)

RC 213/173/025

Duties: To study the distribution of livestock breeds and to advise farmers on the improvement of animal husbandry.

Qualifications and terms: Candidates must have a university degree with animal husbandry as a major subject and an aptitude for work involving animal production and nutrition. A knowledge of the distribution and feeding values of different grasses and an ability to speak Swahili is desirable. Salary £1,329—£2,757 a year plus a 25% terminal gratuity. 21–27 months contract.

Agricultural Officers

RC 213/173/01

Duties: To demonstrate improved agricultural practices in conjuction with the research services and to control technical staff. To initiate policy and report on programmes for agricultural development and to estimate crop production. To administer government funds and stores.

Qualifications and terms: A degree in Agriculture. A knowledge of Swahili and experience in tropical agriculture is desirable. Salary £1,329—£2,757 a year plus 25% terminal gratuity. 21–27 months contract.

If you wish to apply for any of these appointments, or you are interested generally in an appointment overseas, please write giving your full name, age and brief particulars of your professional qualifications and experience to the:

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Additional information and application forms will be supplied upon request to the Association of Commonwealth Universities (Branch Office), Marlborough House, Pall Mall, London, S.W.1.

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